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Abey, A.E., Apparatus for deformation tests at intermediate strain rates—10^{-2} to 10^{-2} s^{-1}—and at high pressure, 3:1118 (UCRL–79012)

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 43127

42100 (NRC/AMPS/RM—78-1) **Limitations of rock mechanics in energy-resource recovery and development.** (National Science Foundation, Washington, D.C. (USA). Panel on Rock Mechanics Problems that Limit Energy Resource Recovery and Development). 1978. Contract EG-77-C-10-0022. 78p. Dep. NTIS, PC A05/MF A01.

Rock-mechanics problems which limit energy-resource recovery and development are assessed. The most serious limitations were found in the fields of geothermal exploration, mining and in-situ recovery, nuclear-waste disposal, oil and gas recovery, underground storage, and under-ocean tunneling. Recommendations include research to determine and predict porosity, permeability, and fluid flow in situ; research to develop better methods for determining and obtaining shallow and deep in situ stresses; research to improve the ability to map fracture patterns, particularly major fractures and faults, at depth; research to improve the understanding of rock-fragmentation processes for increasing the effectiveness of drilling and excavation systems; research to increase understanding of the relation of laboratory-measured quantities to in situ conditions; and research to provide the thermophysical and thermomechanical properties of rock, including fractured rock. (JRD)

42101 (PB—275645) **Coal/energy study issue, update, 1976. Amended completion report.** Davidson, J.R. (Wyoming Univ., Laramie (USA). Water Resources Research Inst.). 1976. 109p. NTIS PC A06/MF A01.

The study investigated the issues and concerns relating to the expected development of coal/energy resources in the Northern Great Plains region. The areas of concern included: trace elements, atmospheric effects, coal resources mining techniques and waste disposal problems, surface resources (including reclamation of strip-mined areas), water resources (quality and quantity), economic and social issues, institutional issues, and general technology.

42102 (PNL—2500(Pt.4)) **Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.** Nielsen, J.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1978. Contract EY-76-C-06-1830. 84p. Dep. NTIS, PC A05/MF A01.

Research programs in the areas of coal, dosimetry, geothermal, and oil shale are briefly indicated. Analytical chemistry support is also summarized. Abstracts were prepared for each of these areas. (JSR)

42103 **International coal projects.** London; IEA Coal Research (1977). 20p.

Report presents a description of the international collaborative work in the field of coal resources, mining and utilization research established under the auspices of the International Energy Agency. The projects include the technical information service; economic assessment service; world coal resources and reserves data bank service; mining technology clearing house; and the fluidized bed combustion project.

PROCESSING

REFER ALSO TO CITATION(S) 43132

42104 (FE—2449-5) **Studies in support of recirculating bed reactors for the processing of coal. Quarterly report, September 1—December 31, 1977.** McGovern, J.J.; McIver, A.E.; Gajdos, L.J.; Bierl, T.W. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Jan 1978. Contract EX-C-76-01-2449. 23p. Dep. NTIS, PC A02/MF A01.

Coal Mixer Modelling Studies is an experimental program created to examine physical mixing of densely entrained gas-solids streams in a plastic model (Cold Model) of a Recirculating Bed Reactor. The solids feeder subsystem became operational during the current reporting period, and initial mixing experimnts have been performed. Current efforts are directed at establishing the operating characteristics of the apparatus and a basis for future mixing experiments. Coal Hydrodesulfurization Studies seeks to achieve two objectives: a process objective which examines the potential for hydrodesulfurization (organic sulfur) of eastern agglomerating coals, and a chemistry objective which pursues a greater understanding of the coal sulfur chemistry. Char sulfidation studies are underway; however, hydrodesulfurization experiments in the flow reactor have been delayed due to problems with two items on the critical path: leaks at seals in the high temperature zones of the reactor and problems with the solids feeder subsystem.

CARBONIZATION

42105 (FE—1220-34) **Clean coke process: process development studies. Monthly report, January 1978.** (USS Engineers and Consultants, Inc., Pittsburgh, Pa. (USA)). Feb 1978. Contract EX-76-C-01-1220. 21p. Dep. NTIS, PC A02/MF A01.

To provide feed for the carbonization PDU until the United Mine Workers' strike is settled, a 4-ton supply of Robena mine coal was obtained from a stockpile at U.S. Steel's Clairton Works. Work is in progress on drying and pulverizing it in the coal-preparation PDU. Samples of neat tar (wash-oil-free) from first-stage carbonization of both West Kentucky and Pittsburgh Seam coals in the 3-inch bench unit were characterized by distillation and by analysis of the chemical-oil fractions. Results from these studies are presented in this report. Test results were obtained on cylindrical formcoke specimens prepared with treated hydrogenation-derived binder. These specimens showed an average crushing strength of 11,900 psi, which is more than 40 percent greater than specimens prepared with untreated binder. The improved binder was treated in the 9-gallon bench unit by air-blowing at 300°C followed by heat soaking at 380°C. A second batch of airblown, heat-treated binder has been prepared for use in the coke-preparation PDU. The vertical-shaft coking kiln was operated to complete final carbonization of pellets produced and cured in the preceding quarter. Both batches of test pellets gave weak coke products of low crushing strength. Bench test results indicate the importance of reducing char particle size to minus-100 mesh to obtain strong formcoke products.

42106 **Apparatus for providing waste gas recirculation in coke oven batteries.** van Ackeren, J.; Helm, E.J. (to Koppers Co., Inc.). US Patent 4,061,544. 6 Dec 1977. Filed date 3 May 1976. 6p.

In a coke oven battery, a part of the waste heat gas is recycled to mix with and dilute the rich fuel heating gas, using conduits and valve mechanisms outside the brickwork constituting the battery proper.

42107 **Method and apparatus for producing form coke.** Lorenz, K. US Patent 4,050,990. 27 Sep 1977. Priority date 14 Aug 1974, German, Federal Republic of (F.R. Germany). 8p.

A method is disclosed for producing form coke, that is coke having pieces of substantially identical form, using a heated shaft furnace, mixing fine coke with a caking coal and pressing the mixture at temperatures at which the mixture is plastic in order to form briquettes. The briquettes are permitted to harden and degasify

and thereafter they are exposed to a high temperature after hardening for example to a temperature of from 400 to 900°C from 60 to 120 minutes. Thereafter the briquettes are cooled. A first mixing substance is prepared by permitting a fine coal to fall in a non-compressed stream in the shaft furnace while heat is transferred thereto substantially by radiation.

42108 Housing construction extending over the coke discharge area of a horizontal coke oven battery. Still, C.O.; Aust, W.D. US Patent 4,050,992. 27 Sep 1977. Priority date 2 Oct 1974, German, Federal Republic of (F.R. Germany). 4p.

A housing structure for use with a coke oven battery having a plurality of horizontally arranged ovens with a master gangway extending horizontally alongside the battery and which is provided with a trackway thereon along which a coke cake guide car is movable comprises a housing having a roof which extends outwardly from the gangway. The housing roof structure is located above the height of the coke cake guide car and also overlies a conveyor for the coke which extends alongside the battery adjacent the gangway. The conveyor in most instances is a quenching car or a belt conveyor. The housing structure has a plurality of longitudinally spaced openings corresponding in dimensions and locations to the coke oven openings. The housing also includes an arrangement for the offtake of gas and dust.

DESULFURIZATION AND PURIFICATION

42109 (PB—274113) Pilot plant study of conversion of coal to low sulfur fuel. Final report Jun 73—Mar 75. Fleming, D.K.; Smith, R.D. (Institute of Gas Technology, Chicago, Ill. (USA)). Oct 1977. Contract EPA-68-02-1366. 156p. NTIS PC A08/MF A01.

The report gives results of a program to develop, on bench and pilot scales, operating conditions for the key step in the IGT process to desulfurize coal by thermal and chemical treatment. This process, to date, uses the 'sulfur-getter' concept. (A sulfur-getter is a material that has a greater chemical affinity for sulfur than coal has.) Lime was the sulfur-getter for this program. In Phase I, a coal/lime mixture was experimentally treated at atmospheric pressure with a reducing gas in a heated, fluidized bed reactor, which could treat up to 200 lb/hr of mixture to 1200 F. The coal was Illinois No. 6, containing about 3% sulfur. Initial work resulted in the discovery that less sulfur was removed than expected. Two factors were believed responsible: the coal heat-up rate in the fluidized bed was nearly instantaneous, which appeared to cause organic sulfur fixation; and the coal showed signs of weathering (therefore, the total sulfur content was not readily available for hydrogen treatment). Phase II redirected the program to the operation of smaller scale units featuring: controlled heat-up rates, an increased number of tests over a broader range of conditions (with savings in time and manpower), and coal samples from several U.S. mines. A coal/lime mixture was treated with hydrogen, in batch reactors, to 1500 F. Tests indicated that lime treatment does not capture all sulfur released from the coal.

42110 Coal desulfurization during gaseous treatment. Huang, E.T.K.; Pulsifer, A.H. (Iowa State Univ., Ames). *ACS Symp. Ser.;* No. 64, 290-304(1977).

Temperature is an important factor influencing desulfurization in all three gases tested. The holding time at temperature is less important, except in the case of oxidizing atmospheres or hydrogen above 600°C where the sulfur content of the sample decreases with increased holding time. The mechanism and extent of desulfurization also depends upon the gaseous atmosphere. Sulfur removal in nitrogen and in hydrogen below 600°C is caused mainly by pyrolysis and release of volatile matter. Hydrogen reacts directly with sulfur in the organic portion of the coal only at 600°C or above. Pyritic sulfur removal is greater in oxidizing atmospheres. In the experiments some inorganic sulfur was transformed into organic sulfur during the gaseous treatment. The fractions of inorganic and organic sulfur released as gases and the fraction of inorganic sulfur transformed into organic sulfur were estimated for each of the gas atmospheres and conditions of temperature and time used.

42111 Oxidative desulfurization of coal. Friedman, S.; Lacount, R.B.; Warzinski, R.P. (Pittsburgh Energy Research Center). *ACS Symp. Ser.;* No. 64, 164-172(1977).

Both pyritic and organic sulfur in coal can be removed by a variety of oxidation techniques, including treatment with NO/sub x/ , peroxygen compounds, air in the presence of specific organic media, or air and water at elevated temperature and pressure. The most promising method involves contacting an aqueous slurry of coal with air at pressures up to 1000 psi and temperatures of 140° to 200°C. Coals from different geographic areas of the US have been treated with air and water in this way, resulting in removal of more than 90% of pyritic sulfur and up to 40% of organic sulfur as sulfuric acid, which is separated from the desulfurized coal by filtration. Fuel value losses are usually less than 10%. Costs for processing coal by this procedure will be somewhere between the less efficient, less thorough and less costly physical coal cleaning methods and the more thorough but much more costly coal conversion techniques. Oxidative desulfurization potentially can upgrade up to 40% of the bituminous coal in the US to environmentally acceptable boiler fuel and can bring most of the rest of the bituminous coals at least close to acceptability with relatively little loss in total fuel value.

HYDROGENATION

REFER ALSO TO CITATION(S) 42140, 42150

42112 (FE—2334-8) Phase and volumetric equilibria in coal hydrogenation systems. Annual report, April 1977—March 1978. Kobayashi, R. (Rice Univ., Houston, Tex. (USA). Dept. of Chemical Engineering). 1978. Contract EX-76-S-01-2334. 11p. Dep. NTIS, PC A02/MF A01.

Apparatus is being assembled and calibrated to measure thermodynamic properties of various organic compounds of interest in coal conversion as follows: Deco points, hydrogen solubility, vapor liquid equilibria, K values, etc. The measurements will be made on very pure zone-refined compounds, which are needed because of the extreme sensitivity of physicochemical properties to composition, particularly when structural dissimilarities are involved. (LTN)

GASIFICATION

REFER ALSO TO CITATION(S) 42147, 42148, 42213, 42214, 42219, 42621

42113 (ANL—78-6) Materials technology for coal-conversion processes. Twelfth report, July—December 1977. Ellingson, W.A. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 97p. Dep. NTIS, PC A05/MF A01.

In the evaluation of ceramic refractories for slagging gasifiers the preliminary measurements reported for the relative corrosion resistance of the magnesia-chromia refractories tested in Run 5 have been revised. Significant slag penetration (40 to 50 mm) was observed for all bricks in Run 5. A second-generation coal-feed-line elbow instrumented for erosive wear detection was installed in the Synthane Pilot Plant, and the first-generation elbow has been examined after exposure to 2.2 x 10^6 kg (approximately 2400 tons) of crushed coal conveyed. Laboratory and theoretical results suggest that a quantitative acoustic leak-detection system may be possible if the leakage flow is "choked,", i.e., the exit velocity from the leakage channel is sonic. This is likely to be the case for the relatively large leaks of interest in high-pressure lockhopper applications. Oxidation-sulfidation studies of Fe-Cr-8 wt % Ni alloys with 4, 12, and 22 wt % Cr were conducted at 750 and 875°C in multicomponent gas mixtures that contained CO, CO_2, CH_4, H_2, and H_2S. The reaction processes resulted in parabolic kinetics. For a given sulfur partial pressure, the oxygen partial pressures required for the formation of a continuous oxide layer in an Fe-22 wt % Cr-8 wt % Ni alloy were approximately 10^2 and 10^3 times those calculated for Cr-Cr_2O_3 equilibrium at temperatures of 875 and 750°C, respectively.

42114 (CONF-780222—2) Production and use of low and medium Btu gas. Patterson, R.D.; Bolez, C.A. (Gilbert Associates, Inc., Reading, Pa. (USA). Energy Research Div.). 27 Feb 1978. 31p. Gilbert Associates, Reading, PA.

From 5. energy technology conference; Washington, DC, USA (27 Feb 1978).

The low pressure, fixed bed gasifier producing low Btu gas has the lowest initial cost up to an output of about 100 billion Btu's per day. The operating costs of the three evaluated gasification systems are approximately the same. The estimated gas price for the low Btu gas system is between 3 and 4 dollars per million Btu's. The low Btu gas system appears to be the most economical up to about 50 billion Btu per day capacity at which point a fixed bed pressurized system producing medium Btu gas is lower in cost. Medium Btu gas produced by an entrained flow atmospheric system appears to become economical at about 150 billion Btu's per day. The sizes of the systems evaluated in this paper would primarily find application in the chemical, petroleum refining, or petrochemical industries in the industrial sector of our economy. Application could also be found in the utility sector. Smaller systems in the 150 ton (2.5 billion Btu's/day) to 600 ton (10 billion Btu's day) represent logical sizes for the remaining industrial sector. The scope of the studies did not include gas distribution or retrofitting. Depending upon specific end use and plant logistics, the costs associated with utilization of medium/Btu gas from the pressurized gasifier could be considerably more attractive than if a low pressure air or oxygen blown gasifier were used.

42115 (CONF-780222—4) Westinghouse fluidized bed coal gasification system: experience and plans. Holmgren, J.D.; Salvador, L.A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced

Coal Conversion Dept.). 1978. Contract EX-76-C-01-1514. 6p. Dep. NTIS, PC A02/MF A01.

From 5. energy technology conference; Washington, DC, USA (27 Feb 1978).

A comprehensive program is underway to evaluate the Westinghouse fluidized bed coal gasification system for a combined cycle power plant. Such a plant is expected to be lower in capital costs, lower in pollutant emissions and have the potential for higher overall plant efficiency when compared with conventional power plants. A 15 ton/day Process Development Unit (PDU) has been constructed at Waltz Mill, PA, to investigate the coal gasification process, and testing has been in progress since early 1975. Most of the reactor design criteria initially specified for the PDU have been realized in the test operations completed to date. Test runs have been conducted with a variety of coal and char feedstocks including non-caking or mildly-caking Wyoming and Indiana coals as well as highly caking Pittsburgh coals. Steady state tests of extended times have been achieved with high carbon utilization efficiencies and production of acceptable product fuel gas. Plans are in progress to demonstrate the process on a larger scale.

42116 (FE—1793-26) **Coal feeder development, Phase II. Progress report, 1 October 1975—30 June 1977.** (Foster-Miller Associates, Inc., Waltham, Mass. (USA)). Nov 1977. Contract EX-76-C-01-1793. 166p. Dep. NTIS, PC A08/MF/A01.

Testing of the prototype centrifugal feeder has given encouraging results. Correlation between theoretical predictions of performance and actual test results has been good. It is recommended that the development and testing of a 500 psi prototype centrifugal feeder be undertaken. In testing to date, the prototype piston feeder has achieved a 200 pounds per hour feed rate at receiver pressures of 500 psi. Performance has been hampered by unreliable operation of the feeder intake and exhaust valves. Further development of the prototype feeder is recommended with emphasis on improving valve performance. Limited testing of the linea pocket feeder prototype has revealed no significant problem areas to date.

42117 (FE—2204-13) **High mass flux coal gasifier extended run operations: Phase II program. First Quarterly technical progress report, February—April 1977.** Simpkin, A.J. (Bell Aerospace Textron, Buffalo, N.Y. (USA)). May 1977. Contract EY-76-C-01-2204. 19p. Dep. NTIS, PC A02/MF A01.

The overall program objective is to demonstrate the feasibility of using a rocket combustor type reactor as a High Mass Flux Gasifier to economically produce low Btu gas and to evaluate the operating characteristics of the device. Basic reactor feasibility has been demonstrated. During the Phase II program, initiated in February 1977, twenty one-hour duration tests will be conducted to demonstrate reactor durability and performance. Two reactors will be designed and fabricated and the test facility will be modified to accommodate one-hour duration tests. Thermodynamic equilibrium analyses will be conducted to establish the best operating conditions for Lignite, Montana Rosebud and Pittsburgh Bituminous coals when reacted with air. Gasification tests will be conducted using these three types of coal. The gasifier will operate at a total mass throughput of nominally 20,000 lb/hour cu. ft. of reactor volume and the coal flowrate will be nominally 0.5 tons/hour. Test results will be analyzed to determine reactor performance and durability, and to evaluate the High Mass Flux Gasifier concept as a gas producer. Test results will be used to upgrade the scaled-up reactor design concept presented in the Phase I Final Report. Work scheduled for the First Quarter consisted of performance analysis, reactor design, test facility design, reactor fabrication and test facility fabrication. Thermodynamic equilibrium analysis was initiated. Reactor design work was completed and fabrication is proceeding on schedule. Test facility design work was running approximately two weeks behind schedule; however, fabrication has been started.

42118 (FE—2433-16) **Environmental assessment of the HYGAS Process. Project No. 9025 quarterly report No. 4, April 1—June 30, 1977.** (Institute of Gas Technology, Chicago, Ill. (USA)). Feb 1978. Contract EX-76-C-01-2433. 40p. Dep. NTIS, PC A03/MF A01.

The environmental assessment program for the HYGAS Process began with HYGAS Tests 55 through 58, which utilized Montana subbituminous coal (nonagglomerating) from the Rosebud seam. Trace element analyses are presented for HYGAS Tests 55 through 58. The analyses for Test 55 are now complete, and interim results are reported for Tests 56 through 58. The final data from Test 55 indicated that beryllium, vanadium, manganese, zinc, lithium, chromium, and lead essentially remained in the ash together with 50% to 90% of the iron (Fe), barium, arsenic, boron, fluorine, thallium, nickel, copper, and molybdenum. The most reactive elements were chlorine, selenium, cadmium, and mercury with less than 50% recovery in the ash. An ash balance also implied that Fe, As, Se, Tl, Ni, Cu, Cd, and Mo were primarily released in the steam-oxygen zone; Ba, B, Cl, F, and Hg were primarily released in the first and second gasification stages. Additionally, Fe, Tl, Ni, Cu, Pb, Mo, and Cr had higher concentrations in chars in the first and second stages of gasification than in the coal feed. The trace element distribution reported here may have resulted from the large temperature differences used in various zones of the reactor; in this report the HYGAS reactor is not unique but is comparable to other industrial processes. A comparison of trace element analyses for Tests 55, 56, and 58 with earlier laboratory tests with lignite coal shows that the data agree for Li and Mn; however, substantial differences are evident for the remaining comparable trace elements. Various other results are given with respect to phenols, on-line ion selective electrode analysis for ammonia, fate of sulfur (including material balance), and instrumentation for measuring water quality.

42119 (LA-UR—78-1183) **Mass transfer changes induced in coal blocks during thermal processing.** Vanderborgh, N.E.; Bertino, J.P.; Hopkins, D.N. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780417—9). Dep. NTIS, PC A02/MF A01.

From Western States Section/Combustion Institute; Boulder, CO, USA (17 Apr 1978).

In-situ processing of coals allows energy extraction from underground seams without usual societal and environmental costs of coal technology. Current concepts involve hot-gas underground processing to effect a partial oxidation of the coal, i.e., underground gasification. Modeling these processes requires comprehension of mass transfer mechanisms that drive the thermal transport processes within coal blocks. Mass transfer is initially limited by the relatively low permeability of the naturally occurring material. Pore geometries in coal suggest that mass transfer channels are near 50 nm. These pores are typically filled by absorbed moisture; moisture removal changes permeability by $10^{2.5}$. Once moisture is removed, other absorbed gases, CH_4, CO_2, etc., flush from the interior volume. These combined gases, during the drying steps, control preliminary heat transfer. Modeling studies suggest that heat transfer mechanisms switch from conduction to convection as permeability is changed from 0.01 md to 5 md, those variations in mass transfer resistance formed during coal drying. Results that predict heat transfer rates in blocks of subbituminous coals during the initial drying stages of in-situ processing are described.

42120 (MERC/CR—78/3) **Computer modeling of the Morgantown Energy Research Center's fixed bed gasifier.** DeSai, P.R.; Wen, C.Y. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Mar 1978. Contract EY-76-S-20-8039. 136p. Dep. NTIS, PC A07/MF A01.

This report describes the modeling of a fixed bed stirred gasifier operated by the Morgantown Energy Research Center. One objective of this project was to increase the fundamental understanding of existing gasification processes with mathematical modeling, and thereby assist the Department of Energy in its overall project planning. Models are used for scale-up and optimization purposes and also for extrapolation beyond the normal operating conditions. However, very often, due to the complexity of the real system and the mathematical limitations, certain simplifying assumptions are made. Therefore, before using any model, its assumptions and hence its limitations should be examined and clearly understood. The theory and the development of the model are described. Background information about the MERC's and similar commercial gasifiers is provided.

42121 (N—77-31605) **Some studies on a solid state sulfur probe for coal gasification systems.** Jacob, K.T.; Rao, D.B.; Nelson, H.G. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Aug 1977. 22p. (NASA-TM—78428; A—7162). NTIS PC A02/MF A01.

Measurements on the solid electrolyte cell ($Ar + H_2 + H_2S/CaS + CaF_2 + (Pt)//CaF_2//(Pt) + CaF_2 + CaS/H_2 + H_2+Ar$) show that the emf of the cell is directly related to the difference in sulfur potentials established at the $Ar + H_2 + H_2S$/electrode interfaces. The electrodes convert the sulfur potential gradient across the calcium fluoride electrolyte into an equivalent fluorine potential gradient. Response time of the probe varies from approximately 9 hr at 990°K to 2.5 hr at 1225°K. The conversion of calcium sulfide and/or calcium fluoride into calcium oxide is not a problem anticipated in commercial coal gasification systems. Suggestions are presented for improving the cell for such commercial applications.

42122 (ORNL/TM—6274) **Fossil energy program. Progress report for January 1978.** McNeese, L.E. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 63p. Dep. NTIS, PC A04/MF A01.

Hydrocarbonization run HC-25 was completed using Wyodak coal at a lower system pressure (150 psig) than used in previous runs to obtain information on the effect of pressure on yields. The run proceeded smoothly with no interruption of feed or other difficulties. In support of in situ gasification, block pyrolysis experiments BP-42 and -43 were conducted at 0.3°C/min reaching surface temperatures of 900 and 1000°C, respectively. The toughness of 2¼ Cr-1 Mo in thick sections suitable for large coal conversion systems is

being explored in the pressure vessel and piping materials work for material in the as-fabricated condition. Equipment modification for plasma spraying of CoCrAlY have been completed in the coatings inspection program. In the welding and cladding program, a range of welding parameters has been found for depositing type 320 Cb stainless steel on carbon steel clad with Inconel 82 that produces no cracking on the finished surface. The corrosion data from the fireside corrosion tests for types 304, 316, and 310 stainless steel, Alloy 600, and Alloy 800 exposed to the Fluidyne atmospheric fluidized bed combustor for 500 hr and 1500 hr are summarized. High-temperature specimens for a 3000 hr run have been prepared. A failure analysis of heat exchanger tubes from the Morgantown Energy Research Center fluidized bed combustor and progress in examining corrosion surveillance coupons from the Wilsonville, Alabama, solvent refined coal plant are reported. In the gas-fired potassium boiler experiment, about 5 hr of stable boiling operation was obtained at power levels up to about 3.5 x 10^6 Btu/hr. An evaluation was initiated of an in-situ facility for producing methanol which would then be converted to gasoline via the Mobil-M process. An effort was also initiated to develop a computer model for the HYGAS gasifier.

42123 (ORNL/TM—6329) **Fossil energy program. Progress report for February 1978.** McNeese, L.E. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 54p. Dep. NTIS, PC A04/MF A01.

In support of in situ gasification, block pyrolysis experiment BP2-44 was conducted in which a bituminous coal block was heated to 650°C in three steps using a H_2 reactor purge gas. Swelling of the block and plastic behavior during pyrolysis were substantially reduced at the higher heating rate of this experiment (5 C°/min) compared with previous experiments at a heating rate of 3 C°/min. The first CoCrAlY specimens have been plasma sprayed in our coatings inspection program. In the welding and cladding program, the first samples of 2¼ Cr-1 Mo steel with a clad overlay of type 320 Cb were prepared by submergered arc welding with an alloy-fortified flux. No fissuring was detected either visually or by dye penetrant inspection. Experimental work in the fireside corrosion tests to expose various heat exchanger tubes at the Fluidyne atmospheric fluidized bed combustor continues. Scale on types 304, 310, and 316 stainless steels and Alloy 800 exposed for 1000 and 1500 hr is composed primarily of Ca compounds and coal ash with minor amounts of iron, nickel, and chrome oxides. In the gas-fired potassium boiler experiment, 4.5 hrs of stable boiling operation was obtained at power levels up to about 3 x 10^6 Btu/hr. A potassium leak occurred at a 2-in. tee where liquid potassium streams from the condenser and the gas separator mix. Work is in progress for repairing the system. In the work on environmental controls for low-BTu gasification, preliminary estimates of the raw, low-Btu product gas and the aqueous wastes likely to be generated in the gasification of coal by four representative gasifiers have been developed. Work continued on an evaluation of an in situ coal gasification facility for producing methanol which would then be converted to gasoline via the Mobil-M process.

42124 (PB—274947) **First trials of chemically active fluidized-bed (CAFB) pilot plant on coal. Final report Jul—Aug 76.** Lyon, D. (Esso Research Centre, Abingdon (UK)). Mar 1977. Contract EPA-68-02-2159. 52p. NTIS PC A04/MF A01.

The report gives results of a minirun, carried out on a 0.75-MWe continuous, chemically active fluidized-bed (CAFB) pilot plant during July-August 1976, as part of a program to extend the CAFB process to operate on coal. After 8.5 hours of gasification on Texas lignite and Illinois No. 6 coal, no major barriers were identified. The quality of the gas produced was similar to, and the desulfurizing efficiency on coal appeared to match or exceed, that for oil. The target of 88% lignite utilization was approached in the minirun under conditions which were far from optimum. Because of the need for more air to gasify coal, a CAFB unit dimensioned for fuel oil will probably have an energy capacity 30% lower when on coal. Satisfactory regeneration while gasifying on lignite was demonstrated, but control of regenerator temperature was more difficult. A new fines return system worked well, but did little to reduce the fly-ash level in the boiler during coal gasification. Operation of the pilot plant on an intermittent, as opposed to round-the-clock, basis was successfully demonstrated.

42125 (PB—275642) **Pike County energy research and development project cost/effectiveness study of energy plant. Final report.** Haywood, C.F. (Kentucky Univ., Lexington (USA). Coll. of Business and Economics). Aug 1977. 61p. NTIS PC A04/MF A01.

This report discusses the costs of construction and operation of a coal-gasification energy plant to serve a commercial and industrial site in Pike County, Kentucky. It provides comparative costs on other alternative energy sources that are considered feasible.

42126 (PERC/RI—78/2) **Effect of reduction temperature, carbiding, and sulfur poisoning on the methanation activity of Raney nickel.** Baird, M.J.; Weinberger, D.T.; Delzer, G.; Hobbs, A.P.; Pantages, P.; Steffgen, F.W. (Department of Energy, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). Apr 1978. 29p. Dep. NTIS, PC A03/MF A01.

The effects of reduction temperature, carbiding and sulfur poisoning on the methanation activity of Raney nickel were investigated. A combination of techniques such as BET surface areas, H_2 and CO chemisorption, ESCA measurements and activity tests were used to characterize the catalyst before and after deactivation. The following reductions in catalytic activity, as determined in a pulse microreactor at 320°C, were observed for the deactivated samples. Initial heating of the catalyst for 3-½ hours at 500°C and 1 hour at 600°C in 8 percent H_2 in helium lowered CO conversion by 12 and 24 percent, respectively, when compared to a sample that was reduced for 1 hour at 400°C. The methanation activity of Raney nickel at 320°C was drastically lowered following a precarbiding treatment at 263°C. Surface poisoning with H_2S caused a greater reduction in methanation activity than that attributed to the corresponding decrease in free nickel surface area. A surface carbide and sulfur species were observed by ESCA measurements on samples that were deactivated by carbiding and H_2S poisoning.

42127 (SAND—78-0145) **Estimating the extent of an in situ coal gasification process using a passive seismic technique.** Beckham, L.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 56p. Dep. NTIS, PC A04/MF A01.

Sandia Laboratories fielded a comprehensive instrumentation effort on the Hanna II in situ coal gasification experiment conducted by the Laramie Energy Research Center (LERC) in 1975-76. Instrumentation included temperature, electrical and seismic arrays designed to provide diagnostic information as well as to develop a remote monitoring capability to continuously map the in situ process. Three types of passive seismic signals produced by the gasification process were identified. The times of arrivals of discrete events were used to find the spatial origins of these seismic events by using a linear least-squares technique. These seismic events were found to occur in the overburden above the burning coal seam and are related to subsidence. The seismic signals observed exhibited frequencies as high as 500 Hz and hence attenuated rapidly with distance. However, field data indicate that over 100 signals per day could be detected at 150 to 200 ft. from the source. Three dimensional plots of source locations are presented. The results correlate well with thermal data which provided direct and diagnostic measurement of the process.

42128 (TSR—78/2) **Coal pump development and technical support, 30 January—26 February 1978. Monthly project report.** Murphy, A. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1978. Contract EF-77-A-01-2616. 39p. Dep. NTIS, PC A03/MF A01.

A hitherto neglected mechanism for heat transfer is being considered as a possibly significant contributor to coal extrusion analysis. This is the cyclic vaporization and condensation of coal oils in the screw channel. A fraction of the coal oils can be volatilized at the higher temperature end of the extruder. Since the melt forms an effective gas seal at the die end of the extruder, the vapors are forced to seep back into the cooler incoming bed of particulate coal. The coal oil can condense on the incoming coal thereby heating it by the release of the heat of vaporization. The rate of heat transfer is conditioned by the rate of volatilization and back flow of the condensible material. It would not be necessary that the active cycling fluid be present in large quantities in the fresh coal stock since the recycling would cause a high concentration to develop in the extruder. The consideration of this heat transfer mechanism is important in that it can be the principle mode of heating the solid in the screw channel. It was previously thought that there would be a large temperature difference between barrel surface and the bulk solid. However, the presence of an excess fluid in the screw channel would significantly promote the rate of heat transfer so that the local barrel, solid and screw temperatures would not be as severely differentiated. The presence of the fluid would also cause caking to occur so that the solid transport relations would be affected.

42129 (UCRL—50026-77-4) **LLL In Situ Coal Gasification Project. Quarterly progress report, October—December 1977.** Stephens, D.R.; Minkel, K.J. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The gasification phase of Hoe Creek Coal Gasification Experiment No. 2 at Hoe Creek, Wyoming was carried out. The coal was ignited on Oct. 14, and two reverse-burn links were simultaneously initiated toward the injection well and a dewatering well. Data from traveling thermocouples, fixed thermocouples, and HFEM instrumentation indicated that there were several reverse burn paths near the bottom of the seam. The reverse-burn link to the injection well was completed on Oct. 28, and forward gasification continued for 57 days, until Dec. 25. During forward gasification, 2300 tons of coal were consumed, producing gas with a heating value of, in general, 100 to 150 Btu/scf. A steam-oxygen burn was carried out from Nov. 10 to 12; during this time a 250- to 300-Btu/

scf gas was produced with no operational or safety problems. The results are quite encouraging for steam-oxygen gasification and show that a great deal remains to be learned about reverse combustion. Environmental testing continues at both Hoe Creek No. 1 and No. 2. Concentrations of phenolics in the groundwater at Hoe Creek No. 1 continue to decrease. All subsidence instrumentation at Hoe Creek No. 2 worked, including piezometers, shear strips, borehold extensometers, and slope indicators. Considerable subsurface ground motion was detected. A simple model of reverse-combustion link generation was developed that is in qualitative agreement with Hoe Creek No. 2 data. Because of the low thermal diffusivity of wet coal, the link must pass near a thermocouple for an appreciable temperature rise to be observed in a reasonable amount of time. For distances greater than 1 m, the thermal response within a week is very low. By the time a response is observed, the link would have passed many days earlier.

42130 Method for improving gasification process rates and yields by means of electrophilic aromatic substitution pretreatment of coal. Schlosberg, R.H.; Wright, F.J.; Hartgerink, R.L. (to Exxon Research and Engineering Co.). US Patent 4,072,475. 7 Feb 1978. Filed date 3 Sep 1976. 16p.

Coal is electrophilically aromatically substituted (i.e., alkylated or acylated) in the presence of an alkylating or acylating agent with or without a catalyst under mild conditions to give a treated coal product. This treated coal product may then be solvent extracted to give an extract and an upgraded coal residue, with this residue being subjected to a gasification process procedure or the treated coal product may be subjected to gasification process procedures without any prior extraction being performed. By means of either technique, a material is prepared for which the rate of gasification and the yield of desired product upon gasification is dramatically increased when compared with nonelectrophilically aromatically substituted material (i.e., raw coal). An improved gasification process is disclosed comprising the steps of electrophilically aromatically substituting coal and subjecting such pretreated coal, either extracted or unextracted to gasification process techniques.

42131 Method for in situ combustion. Pasini, J. III; Shuck, L.Z.; Overbey, W.K. Jr. (to Energy Research and Development Administration). US Patent 4,062,404. 13 Dec 1977. Filed date 30 Sep 1976. 6p.

PAT-APPL-728,358.

This invention relates to an improved in situ combustion method for the recovery of hydrocarbons from subterranean earth formations containing carbonaceous material. The method is practiced by penetrating the subterranean earth formation with a borehole projecting into the coal bed along a horizontal plane and extending along a plane disposed perpendicular to the plane of maximum permeability. The subterranean earth formation is also penetrated with a plurality of spaced-apart vertical boreholes disposed along a plane spaced from and generally parallel to that of the horizontal borehole. Fractures are then induced at each of the vertical boreholes which project from the vertical boreholes along the plane of maximum permeability and intersect the horizontal borehole. The combustion is initiated at the horizontal borehole and the products of combustion and fluids displaced from the earth formation by the combustion are removed from the subterranean earth formation via the vertical boreholes. Each of the vertical boreholes are, in turn, provided with suitable flow controls for regulating the flow of fluid from the combustion zone and the earth formation so as to control the configuration and rate of propagation of the combustion zone. The fractures provide a positive communication with the combustion zone so as to facilitate the removal of the products resulting from the combustion of the carbonaceous material.

LIQUEFACTION

REFER ALSO TO CITATION(S) 42113, 42122, 42123, 42158, 42159

42132 (BERC/RI—78/4) **Characterization of a Colstrip coal liquid derived from the zinc chloride hydrocracking process.** Sturm, G.P. Jr.; Woodward, P.W.; Vogh, J.W.; Holmes, S.A.; Dooley, J.E. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). May 1978. 27p. Dep. NTIS, PC A03/MF A01.

In a continuing series of characterization studies, the Bartlesville Energy Research Center characterized two distillates and a residue fraction derived from a Colstrip coal liquid produced by the Conoco Coal Development Co. molten zinc chloride catalytic liquefaction process. Procedures, established in earlier work on the heavy ends of petroleum, were slightly modified and applied to these materials. The techniques include several applications of chromatography and instrumental analyses. Although only 40% of the original coal liquid was submitted for analyses, the results were unique in that the portion of the coal liquid analyzed contained a significantly higher amount of monoaromatics as compared to other liquids characterized by use of these procedures.

42133 (CONF-780415—3) **SEM and EMA studies of an SRC pilot plant carbonaceous plug.** Harris, L.A.; Yust, C.S. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 7p. Dep. NTIS, MF A01.

From Scanning electron microscopy conference; Los Angeles, CA, USA (16 Apr 1978).

Portions of document are illegible.

Scanning electron microscopy (SEM) and electron microprobe analyses (EMA) have proven to be extremely useful methods for analyzing microstructures observed in a carbonaceous "plug" retrieved from a feedline of a solvent refined coal (SRC) conversion plant. Typical petrographic micrographs revealed a semi-coke matrix enclosing nearly uniform sized minerals or mineral assemblages, as well as unaltered coal (fusinite) fragments. The identity of the minerals, by SEM and EMA, revealed two distinct mineral-types within the plug, namely minerals that have undergone transformations such as pyrite (FeS_2) → pyrrhotite (FeS), and those minerals that are essentially unaltered; for example, quartz and kaolinite. The examination of porous areas within the semi-coke constituent showed a variety of solidified "mesophase" spherules either as individuals or as coalesced groups. These observations are significant in that they reveal the mechanism by which semi-coke forms; i.e., via spherical liquid crystals separating from the coal and solvent oil slurry. Additional structural features associated with the semi-coke were observed such as ridges along the pore walls composed of coalesced spheres in a chain-like growth.

42134 (DOE/EDP—0012) **Environmental Development Plan (EDP). Coal liquefaction program, FY 1977.** (Department of Energy, Washington, D.C. (USA)). Mar 1978. 113p. Dep. NTIS, PC A06/MF A01.

This document addresses the following fossil fuel technologies associated with ERDA's Coal Liquefaction Program for the development of coal or coal-derived fuels in the following process categories: Direct hydrogenation, solvent extraction, pyrolysis, and indirect liquefaction. For each developing technology the EDP (a) considers all potential areas of environmental, health, and safety problems, (b) determines needed activities for each problem, and (c) identifies applicable ongoing activities. The requirements for new environmental research are defined, taking into consideration work which has been accomplished or is underway. The environmental research requirements are categorized as follows: Characterization and monitoring of pollutants, evaluation of environmental control techniques, evaluation of potential ecological effects, evaluation of potential health and safety effects, analysis of pollutant transport and transformation phenomena, analysis of interaction and synergistic impacts, EIA/EIS preparation, water resources assessment, evaluation of the applicability and enforcement of emission, effluent, waste disposal and health and safety standards. Although many of the issues associated with conventional fossil-fuel utilization are common to coal conversion processes, liquefaction technology also presents the following unique environmental, health and safety issues: development of industrial hygiene programs and safeguards to protect workers; identification of materials with carcinogenic, mutagenic and related effects, their sources and controls; characterization and treatment of wastes and fugitive emissions and effluents; and, disposal of sludges and solid wastes.

42135 (EPRI-AF—681(Vol.1)) **H-Coal integrated pilot plant. Final report.** (Hydrocarbon Research, Inc., Trenton, N.J. (USA)). Mar 1978. 54p. Dep. NTIS, PC A04/MF A01.

Phase I of the H-Coal Program consists of the design of a 200/600 ton per day coal liquifaction pilot plant and a laboratory program to support this design. This final report covers the laboratory effort. The work was carried out by Hydrocarbon Research, Inc., at their Trenton, New Jersey, labs and Morristown, New Jersey, engineering offices. The H-Coal process catalytically converts coal to oil in an ebulated bed reactor. Advantages of this process include flexibility of operation, constant catalyst activity level through on line addition and withdrawal of catalyst and reactor back mixing which allows low temperatures of the reactor feed streams. The 3 ton per day PDU was operated to demonstrate: (a) heavy boiler fuel oil mode operation, (b) operation at commercial reactor gas velocities, and (c) operation with high residum concentration in the reactor. Solid liquid separation was demonstrated by antisolvent precipitation, high vacuum distillation and hydrocloning. This lab program provided improved vapor-liquid K values and improved on the H-Coal reactor internals design. Finally, the Technical Management Plan for Phase III—Operations of the large pilot plant—was developed.

42136 (EPRI-AF—681(Vol.2)) **H-Coal integrated pilot plant. Final report.** (Hydrocarbon Research, Inc., Trenton, N.J. (USA)). Mar 1978. 481p. Dep. NTIS, PC A21/MF A01.

Phase I of the H-Coal Program consists of the design of a 200/600 ton per day coal liquifaction pilot plant and a laboratory program to support this design. This final report covers the laboratory effort. The H-Coal process catalytically converts coal to oil in an ebulated bed reactor. The 3 ton per day PDU was operated to demonstrate: (a) heavy boiler fuel oil mode operation, (b) operation at commercial reactor gas velocities, and (c) operation with high residum concentration in the reactor. Solid liquid separation was demonstrated by antisolvent precipitation, high vacuum distillation and hydrocloning. This lab program provided improved vapor-liquid K values and improved on the H-Coal reactor internals design. This volume summarizes the data obtained in the bench scale experiments and process development units and includes additional studies on liquid-solids separation and other chemical studies.

42137 (FE—1775-14) **Preliminary design services. Research and development report No. 114. Quarterly report, July—September 1977.** O'Hara, J.B. (Parsons (Ralph M.) Co., Pasadena, Calif. (USA)). 1978. Contract EX-76-C-01-1775. 17p. Dep. NTIS, PC A02/MF A01.

The objective is to develop preliminary designs and economic evaluations for a number of types of coal conversion plants. The following designs are included: Conceptual commercial plant for a coal-oil-energy-development (COED) plant; oil/gas plant to produce liquid fuels plus substitute natural gas (SNG); commercial-scale Fischer-Tropsch plant with motor fuel and SNG as the main products; coal conversion plant to produce power, oil, gas, and other products (POGO); facilities complex capable of demonstrating the commercial feasibility of a variety of coal conversion processes that show promise during pilot plant operations (low-to-high Btu fuel gas, methanol/motor fuel by Fischer-Tropsch process, and clean liquid fuels by alternate liquefaction processes); and preparation of conceptual designs, construction procedure and economics for three types of prestressed concrete pressure vessels for use in coal conversion plants. In addition, supporting efforts will be provided including planning and progress monitoring, equipment development, construction materials development, and environmental factors.

42138 (FE—2031-10) **Chemistry and structure of coal-derived asphaltenes, Phase III. Quarterly progress report, October—December 1977.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1977. Contract EX-76-C-01-2031. 44p. Dep. NTIS, PC A03/MF A01.

The 100 percent solubility limits for Synthoil coal liquid solvent fractions fall within the range: 9-12 hildebrands for asphaltene, and 10-11 hildebrands for carbene; the carboid was found to be essentially completely dissolved only in pyridine, delta = 10.6 hildebrands. VPO molecular weight studies indicate that association of asphaltenes is a function of solvent polarity. Association increases along the series: benzene greater than chloroform greater than tetrahydrofuran, but infinite dilution number average molecular weight values are in close agreement for any asphaltene in these three solvents. GPC weight average molecular weight values for the asphaltenes obtained from the five demonstration processes under study are found to range from 531—615. Electron spin resonance studies of asphaltenes in solution, and temperature dependence studies of solid asphaltenes, and asphaltene charge transfer complexes with TCNE provided no evidence for charge transfer interactions leading to increased signal intensities. Polarographic analyses of coal liquid solvent fractions provided evidence which suggests larger and more aromatic systems are present along the series: carboid greater than carbene greater than asphaltene greater than resin greater than oil. Silylation and methylation of asphaltene silica gel chromatographic fractions provided data on the percentages of hydroxylic oxygen, and basic nitrogen present in each fraction.

42139 (FE—2244-17) **Flash pyrolysis coal liquefaction process development. Quarterly report for July—September 1977 including the September 1977 monthly report.** Knell, E.W.; Gethard, P.E.; Shaw, B.W.; Green, N.W.; Willson, W.G. (Occidental Research Corp., La Verne, Calif. (USA)). 1977. Contract EX-76-C-01-2244. 23p. Dep. NTIS, PC A02/MF A01.

Step-wise modifications to the PDU were successful in improving the char rate control required to achieve extended operation with bituminous coal. The original mechanical char feeder system was replaced with a new feeding device, a lift-tube. A record twenty-two hour run with bituminous coal was made. A preliminary cold flow test unit was built and used for prototype testing of the char lift-tube feeder. The PDU lift tube was designed based on a correlation of data from this testing. Construction was begun on a larger cold flow unit which will permit simulation of the entire PDU char circulation and reactor hydrodynamics. Bench scale reactor experiments show that when coal is pyrolyzed in the presence of char the tar yield is significantly reduced. However, the addition of CO_2 and/or H_2O (steam) to the pyrolysis system brings back the high tar yield characteristic of the ORC FLASH PYROLYSIS process. A modified SARA method to characterize coal tar is under development. On-line gas analysis capabilities were significantly improved by the addition of a third gas chromatograph. Gaseous components up to C_{16} hydrocarbons can now be monitored.

42140 (FE—2305-6) **Investigation of mechanisms of hydrogen transfer in coal hydrogenation. Semi-annual technical progress report, July—December 1976 (Stage I, Phase I report period).** Cronauer, D.C.; Jewell, D.M.; Boyle, J.P. (Gulf Research and Development Co., Pittsburgh, Pa. (USA)). Jan 1977. Contract EX-76-C-01-2305. 24p. Dep. NTIS, PC A02/MF A01.

This report presents progress being made in the study of hydrogen transfer in coal hydrogenation. Stage I consisting of establishing an inventory of model compounds, conducting preliminary experimentation to screen potential acceptors and donors, and establishing analytical techniques has been completed. Sources of model compounds have been established and the synthesis of tagged compounds is well underway. Preliminary donor-acceptor experiments have given a relative ranking of reactivities of acceptors and have established the specific donors along with reaction conditions to be used. Experimentation has also established the advantage of using a batch autoclave system with high temperature reactant charging over a packed-bed flow unit.

42141 (FE—2353-15) **EDS coal liquefaction process development: Phase IIIA. Monthly technical progress report, April 1—April 30, 1977.** Fant, B.T. (Exxon Research and Engineering Co., Baytown, Tex. (USA). Baytown Research and Development Div.). Jul 1977. Contract EX-76-C-01-2353. 40p. Dep. NTIS, PC A03/MF A01.

The process variable study with Wyoming subbituminous coal in the 50 lb/dau Recycle Coal Liquefaction Unit (RCLU) was completed. A process variable study was initiated with North Dakota lignite. Operations were initiated with Wyoming subbituminous coal in the one ton-per-day Coal Liquefaction Pilot Plant (CLPP). The characterization of solvent hydrogenation feeds and products has been greatly facilitated by computerization of procedures to tabulate concentrations of compounds according to classes having common reactivity. Product upgrading studies show that heavy coal liquids produced by the EDS process can be hydrofined to improve compatibility with petroleum based fuel oils. Additional hydrofining studies are in progress to determine the minimum upgrading necessary to make EDS heavy coal liquids compatible with petroleum products. Initial evaluation of liquefaction bottoms processing alternatives has begun, following the validation of adjusted hydrogen manufacturing vectors. Initial slurry preheater tests on CLPP indicate that higher film temperatures may be achieved without coking in mixed-phase preheating than with slurry-only preheating. Short-term tests at a film temperature of 900°F showed no coking in the mixed-phase preheating mode; whereas, some coke was formed in the slurry-only mode at a film temperture of 875°F.

42142 (IS—4379) **Alloy evaluation for fossil fuel process plants (liquefaction). Quarterly report, 1 January 1978—31 March 1978.** Woods, C.M.; Scott, T.E. (Ames Lab., Iowa (USA)). 15 Apr 1978. Contract W-7405-ENG-82. 8p. (FE—7318-6). Dep. NTIS, PC A02/MF A01.

The objective of this program is to evaluate the mechanical properties of liquefaction process plant "dissolver" vessel materials in a "dissolver" vessel environment including coal slurry and pressurized hydrogen gas at temperatures up to 900°F. Specifically, the degradation of notched-bar and smooth bar tensile samples of 2¼ Cr—1 Mo will be monitored as a function of exposure time and stress in the "dissolver" vessel environment. This quarter was spent entirely on installing and debugging the newly acquired pressure vessels and their controlling circuitry. The vessels were installed in the Ames Lab explosion-safe, hydrogen-containment building, specially designed for this program. Leak checks of 24 to 72 hours were performed on the vessels at pressures ranging from 1000 to 5000 psig at temperatures of 72°F and 800°F. Automatic pressure and temperature monitoring controls were tested and calibrated. Pressure vessel furnaces were installed and are being tested. Containment building safety systems including hydrogen detectors, vessel overpressure alarms, vessel over-temperature alarms, hydrogen check valves, surge valves, power failure emergency backup systems and fire alarms were tested and found satisfactory. Individual pressure vessel containment cell blow out panels and cell ventilation systems were found to be satisfactory.

42143 (LBL—6897) **Combustion of solvent refined coal in an opposed flow diffusion flame.** Chin, W.K.; Sawyer, R.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 23p. (CONF-780417—7). Dep. NTIS, PC A02/MF A01.

From Western States Section/Combustion Institute; Boulder, CO, USA (17 Apr 1978).

Interest in the combustion characteristics of coal and coal derived fuels relates primarily to their adaptation in existing and planned combustion devices and their propensity to produce increased pollutant emissions in comparison with petroleum fuels and

natural gas. This work on solvent refined coal (SRC) is part of an experimental study of the mechanism of the burning of coal and coal derived fuels employing an opposed flow diffusion burner. SRC is a reconstituted tar-like material which has been solvent extracted from coal. This refined product is low in both sulfur and ash in comparison with the parent coal. Cylindrical rods were cast for burning, some containing fine imbedded thermocouples. The burning rate of the SRC was measured for a range of oxidizer (oxygen and nitrogen) blowing velocities and oxidizer oxygen mole fractions and the dependency on these parameters determined. The temperature profile in the condensed phase fuel was determined from a time to distance transformation made possible by the steady state nature of the burning. The similarity of the burning characteristics of SRC and pressed pulverized coal suggests that similar mechanisms control the burning of these two fuels in our experiments.

42144 (MERC/RI—78/4) **Concept and use of hydrogen permeable catalysts.** Karr, C. Jr.; McCaskill, K.B. (Department of Energy, Morgantown, W.Va. (USA). Morgantown Energy Research Center). May 1978. 42p. Dep. NTIS, PC A03/MF A01.

The conceptual mechanisms and the use of three different kinds of hydrogen permeable catalyst reactors are discussed: (1) thin-wall nickel tubing, (2) finely porous nickel-molybdenum tubing, (3) finely porous cobalt-molybdenum tubing, each with an inner catalytic coating of metal sulfides. The differences in the reaction mechanisms of the different catalysts for conversion of various pure compounds, coal tar oils, and slurries of coal in hydrogenated tar oil, with hydrogen diffusing through this coating under a differential pressure, are described. The high conversion effects of operating parameters over a range covering conditions as mild as 1.5 to 3 min residence time, and 650 psig hydrogen at 752°F are outlined, as well as the general approach to stoichiometric consumption of available hydrogen, and the self-cleaning effects of hydrogen permeable catalysts. Polycyclic and heterocyclic aromatic compounds were hydrogenated to their hydroaromatic derivatives, and then hydrocracked to lower boiling compounds, as shown by GC/MS analysis.

42145 (UCID—4027) **Coal liquefaction alloy test program. Progress report, August 1—December 31, 1977.** Levy, A.; Lochmann, W.; Anderson, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1977. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

A program to investigate the behavior of materials subjected to the liquid slurry environments in coal liquefaction systems is being conducted. This first quarterly progress report presents the objectives of the program and describes the six work tasks that will be carried out. A literature and plant visit survey to ascertain the nature of the problem and the operational environments to which materials are exposed was made. The primary problem that was identified in carrying out a laboratory scale liquid slurry erosion of materials program is the validity of the test results from a recirculating slurry where the solid particles are continuously being comminuted. Four different test systems have been incorporated into the program to assure that the test results will be applicable to "real world" requirements. The design and operation of each device is described.

42146 **Spent catalyst regeneration apparatus.** Pulak, R.P. (to UOP Inc.). US Patent 4,065,269. 27 Dec 1977. Filed date 12 Apr 1976. 18p.

A catalyst regeneration process and apparatus are disclosed for the oxidation of coke from a spent catalyst and for the conversion of CO resulting from the oxidation of coke to CO_2. Novel feature of the process is the mixing of a portion of regenerated catalyst produced in a coke oxidation zone and heated to a higher temperature in a CO-conversion zone with spent catalyst and passing the mixture to a coke-oxidation zone to increase the temperature within the coke oxidation zone and to disperse spent catalyst more evenly across that zone thereby increasing the rate, extent and evenness of coke oxidation. The regeneration apparatus includes components by which this can be accomplished.

42147 **Coal liquefaction bottoms conversion by coking and gasification.** Lang, R.J. (to Exxon Research and Engineering Co.). US Patent 4,060,478. 29 Nov 1977. Filed date 30 Sep 1976. 14p.

Heavy bottoms produced by the liquefaction of coal or similar carbonaceous solids aree converted into more valuable products by adding an alkaline earth metal compound to the bottoms in a concentration sufficient to give, following pyrolysis of the bottoms, an alkaline earth metal-to-carbon atomic ratio of from about 0.005 : 1 to about 0.1 : 1; pyrolyzing the bottoms at a temperature of from about 900° to about 1600°F, to produce gases, hydrocarbon liquids and coke or char containing added alkaline earth metal constituents; and thereafter gasifying the char with steam.

42148 **Methods of fluidized production of coal in situ.** Terry, R.C. (to In Situ Technology, Inc.). US Patent 4,059,151. 22 Nov 1977. Filed date 4 Mar 1976. 12p.

A method of producing combustible gases, synthetic crude oils, coal chemicals and heat from coal in situ utilizes the combined teachings of in situ gasification, liquefaction and pyrolysis in separated coal blocks.

42149 **Method and apparatus for removal of last traces of soluble ash and elements from solvent refined coal.** Kindl, F.H. (to Encotech, Inc.). US Patent 4,058,976. 22 Nov 1977. Filed date 21 Nov 1975. 10p.

Solvent refined coal is treated with liquid water at a temperature of about 500°-550°F in a closed cylindrical vessel under the saturation pressure 665--1030 psig of water at that temperature and under gentle agitation to insure low shear liquid-solid contact for about $^1/_2$ to 2 hours. Surprisingly, the soluble ash, generally sodium or potassium salts, is leached out to bring the sodium content down from 50-60 parts per million to a value of less than 1 part per million which makes the product very suitable as a feed for direct firing in a gas turbine. In addition the total ash content is reduced from a value of approximately 0.1% to a value less than 0.05% which means that in addition to reducing the quantity of sodium and potassium, there are other constituents of the ash which also have been removed.

42150 **Solubilization and reaction of coal and like carbonaceous feedstocks to hydrocarbons and apparatus therefor.** Cramer, F.B. (to Clean Energy Corp.). US Patent 4,050,904. 27 Sep 1977. Filed date 29 Dec 1975. 16p.

Apparatus is disclosed for effecting an hydrogenation of bituminous coal in dissolved state in molten inorganic salts with active hydrogen derived in situ from dissociated steam and recovery of hydrocarbon vapor products sequentially evolved throughout the reaction zone by progressively stripping later evolved vapors with earlier evolved vapors passed differentially through the reaction stream.

42151 **Filterability of a coal-derived liquid.** Weintraub, M.; Weiss, M.J.; Akhtar, S.; Yavorsky, P.M. (Energy Research and Development Administration, Washington, DC). pp 201-220 of Liquid fuels from coal. New York; Academic Press, Inc. (1977).

Solids separation is an important phase in all coal liquefaction processes. It is a difficult step because of the small particle size, wide size distribution, low density difference between particle and liquid and high viscosity of the liquid. As part of a multi-directional attack on the problem, ERDA has investigated basic principles in filtration of solids from the SYNTHOIL product. A high viscosity material containing 5.7% ash has been consistently batch filtered to below 0.1%, with some values as low as 0.035%. Several filter media were used, including filter paper and a precoat material that can be used on a continuous commercial filter. It was found that the nominal filter medium has little influence on the ultimate product clarity as the true filter medium is the cake that is formed during filtration. The nominal filter medium affects the pressure drop and time required to build a functioning cake. Filtration rates are very sensitive to temperature, but the relation is that of simple inverse proportionality to viscosity. A thin cake, readily distinguishable from the precoat, produces adequate clarity; additional cake increases pressure drop without substantial product improvement. This implies that a continuous precoat filter should be designed to maintain a thin coating of the product cake for optimum filtration.

PYROLYSIS AND CRACKING

42152 (PB—275891) **The conversion of model coal liquids compounds to naphtha species. Final report 1 Jan 73—31 Oct 76.** Haynes, H.W. Jr. (Mississippi Univ., University (USA). Dept. of Chemical Engineering). May 1977. 201p. NTIS PC A10/MF A01.

Four catalysts were tested in a laboratory trickle bed reactor for their activities and selectivities in hydrocracking phenanthrene. All the hydrogenation products of phenanthrene, including high yields of perhydrophenanthrene, were observed in the products from experiments with alumina supported cobalt molybdenum sulfide. In contrast the hydrogenation over chromia-alumina was terminated at sym-octahydrophenanthrene. Hydrogenolysis reactions were also observed over these catalysts. The tendency was to successively hydrogenate and crack at terminal rings though some evidence of a minor reaction path involving saturation and cracking at the central ring was observed with chromia-alumina. A nickel-tungsten sulfide/fluorided alumina catalyst and a palladium loaded rare earth hydrogen Y zeolite catalyst were very active hydrocracking catalysts. The zeolite catalyst was extremely active and a pore diffusion limitation was evident. Approximate calculations indicated that the pore diffusion limitation was likely due to diffusion within the macropore structure rather than the intracrystalline diffusivity. In addition to these experiments the supported Group VIII transition metals (excepts Os) and a commercial zeolite cracking catalyst were investigated in a pulse catalytic microreactor using a variety of hydrocarbon reactants. In all cases naphthalene derivatives were the most prominent cracked products obtained from cracking various partially

hydrogenated phenanthrenes. (Portions of this document are not fully legible)

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 42138

42153 (N—78-11213) **Solubilization of coal in organic media.** Lahaye, P.; Decroocq, D. (National Aeronautics and Space Administration, Washington, D.C. (USA)). Jun 1977. Translated from Solubilisation du Charbon en Milieu Organique, Revue de l'IInstitut Francais de Petrole. (NASA-TM—75118). 44p. NTIS PC A03/MF A01.

Study of the extraction of coal by organic solvents at moderate temperature has allowed us to understand the experimental conditions which will lead to a maximum yield of extract. Based on the results obtained on the effect of the nature of the solvent, it appears to be desirable in reaching this result to make use of binary mixtures or possibly of even more complex ones composed of amines or, more generally, of basic nitrogen-containing compounds. The use of the solvents discussed above was also considered for treatment of kerogen or the organic material contained in sedimentary rocks. Only 10 to 40% of the organic material was extracted from the samples. However, the chemical structure of kerogens is much more varied than that of coals, so it can be expected that kerogens which have undergone a strong evolution through the action of geologic conditions will maintain their very low solubilities, whatever the solvent used.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 42161, 43334

42154 Determination of the granular form coefficients of electrode materials using the Quantimet 720 computerized image analyser. Otlik, A. *Koks, Smola, Gaz;* **22**: No. 4, 120-122(Apr 1977).

The results of measurements of the granular structure of raw and calcined petroleum cokes, pitch coke, blast-furnace coke and anthracite are presented. A number of coefficients were obtained which characterize the form, the anisotropy, and the development of the granular section line. These coefficients may be of use in choosing the optimum raw materials and unitary operations in the manufacture of electrode products.

42155 Desorption phenomena during activated carbon filtration of water containing organic impurities. Haberer, K. *Z. Wasser- Abwasser Forsch.;* **10**: No. 3-4, 82-87(1977). (In German).

Problems of breakthrough of certain organic constituents during the operation of activated-carbon filters were investigated using gas chromatography and electron- capture detectors of high sensitivity. Samples of contaminated river water were passed through activated carbon and the changes in intensity of selected peaks in the filtrate were recorded for increasing periods of operation under various conditions of flow rate and retention period in the filter. Evidence of the gradual desorption of certain less easily adsorbed components was obtained, and the mechanism of this effect is discussed, together with suggestions for minimizing its influence under practical conditions.

42156 Production of carbonaceous absorbents from caking coals. Kostomarova, M.A.; Surinova, S.I. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **10**: No. 6, 1-5(1976).

A method for obtaining spherical carbon adsorbents from caking coal without the use of binders has been studied. Optimum conditions found for the basic stages of the process, and the results of the research are given as regards pore structure, adsorptive properties and mechanical strength.

PROPERTIES

REFER ALSO TO CITATION(S) 42105, 42119, 42138, 42154

42157 (PB—275000) **Preliminary evaluation of sulfur variability in low-sulfur coals from selected mines. Contract report.** Nelson, A.C. (PEDCO-Environmental, Inc., Cincinnati, Ohio (USA)). Nov 1977. Contract EPA-68-02-1321. 157p. NTIS PC A08/MF A01.

Data on the variability of sulfur content and heating value of coal have been obtained from several coal and utility companies. These data have been analyzed to estimate the mean, standard deviation, and the frequency distribution of weight percent sulfur (dry basis) and the impact of this variability on the required average sulfur content to comply with an emission regulation. In order to assess the implications of sulfur variability for compliance with emission regulations, such as those specified by State Implementation Plans(SIP) and New Source Performance Standards (NSPS), the relative standard deviation (RSD) of weight percent sulfur was estimated as a function of the amount of coal sampled and the number of composite samples for the specified averaging period. These RSD's were used to estimate the required average sulfur content to yield 95 and 99 percent compliance with the emission limitation of 1.2 lb SO2/MM Btu. The detailed computations are given for two sizes of power plants, 500 MW and 25 MW (250 MM Btu/hour, the smallest plant covered by the NSPS). As the percent of compliance increases the required average sulfur content decreases and rapidly approaches sulfur levels for which the availability of uncleaned coal to comply with the NSPS would approach zero.

42158 (PERC/TPR—78/1) **Improved method for the analysis of coal liquids.** Mair, B.J.; Spitler, C.A. (Department of Energy, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). May 1978. 10p. Dep. NTIS, PC A02/MF A01.

The starting material for this investigation was a composite heavy oil from coal liquefaction products remaining after the asphaltenes and benzene insolubles had been removed from the original coal-derived liquids. This material was distilled at low pressures to remove volatile material which would be lost during the removal of solvents used in the subsequent processing. This investigation describes methods for the separation of the heavy oil fraction of a coal liquefaction product into two portions, one containing most of the non-hydrocarbon material (acids, bases, and neutral nitrogen compounds), the other portion hydrocarbons plus ethers and thio-ethers. Subsequent separation and determination of the saturates, 1-ring, 2-ring, 3-ring, 4-ring-and higher-ring aromatic material in the largely hydrocarbon portion are also described. Grade 62 silica gel impregnated with $FeCl_3$ has been found to be a superior adsorbent for the chromatographic separation of the acids, bases, and neutral nitrogen compounds from the largely hydrocarbon components of the heavy oil fraction of a coal-derived liquid. A new chromatographic charge transfer method for the separation and determination of the main components in the largely hydrocarbon portion of coal liquids has been developed. With this method, a short section at the bottom of the column is packed with Grade 923 silica gel and the remaining upper part with Grade 62 silica gel impregnated with trinitrophenol (TNP). In a single experiment the material is separated into saturates, 1-ring, 2-ring, 3-ring, 4-ring, and higher-ring aromatics.

42159 (SAND—78-0088) **Sandia Fossil Fuel Analytical Laboratory: procedures used in coal liquefaction analyses.** Thomas, M.G.; Noles, G.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 50p. Dep. NTIS, PC A03/MF A01.

Detailed descriptions of equipment, procedures and techniques used for analyzing products from the Sandia Autoclave Facility and the Bench Scale Flow Reactor/Preheater are presented. Asphaltenes, pentane soluble oil, preasphaltenes, and sulfur are determined by solvent extraction within a precision of 0.2%. Viscosity is measured with a Brookfield Viscometer between 1-10,000 centipoise at 60° to 70°C with a precision of 0.5%. Solvents are removed from coal-derived products (CDP) by vacuum distillation between 40 to 90°C and 1 to 300 torr, and the CDP is distilled between 70 to 1000°F at 1 to 3 torr. Gel Permeation Chromatography is used to determine molecular weights of CDP between 100 to 2000 and for quality control. Internal consistency of analytical results based upon sulfur balance and data precision from replicate analyses is within 5%. New techniques have been developed to provide quantitative gas analysis by gas chromatography, simulated distillation of CDP following the ASTM D2887-73 procedure, and asphaltene analysis by liquid chromatography.

42160 Method for the preparation of noncaking coals from caking coals by means of electrophilic aromatic substitution. Schlosberg, R.H.; Gorbaty, M.L.; Lang, R.J. (to Exxon Research and Engineering Co.). US Patent 4,059,410. 22 Nov 1977. Filed date 28 Jun 1976. 8p.

A method is disclosed for the preparation of and pretreatment of coal, which coal will not cake when subjected to standard coal conversion processes, which method comprises the steps of electrophilically aromatically substituting the coal yielding alkylated or acylated products thereby.

42161 Abradability investigations of coarse grain products of coal and graphite. Lukoszek, J. *Koks, Smola, Gaz;* **22**: No. 4, 110-113(Apr 1977).

The products of prepared coal, and, in particular, linings, were exposed to abrasion by granular materials. The abradability was obtained both by the Marshall-Morgan method and using the Taber abrader. Measurements on coal and graphite materials yielded results which correlate with other physical and chemical properties of the materials tested.

42162 Kinetic laws of the change in oxygen-containing groups in the high-temperature oxidation of hard coals. Kompanets, V.A. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 23-28(Jan 1977).

The kinetic laws of the change in various oxygen-containing forms for the high-temperature stage of the oxidation of hard coals have been studied. The effective activation energy of the accumulation of peroxide, phenol, carbonyl, and carboxy groups and of the absorption of oxygen has been calculated. Information is given which characterizes the decomposition of peroxide groups in an inert atmosphere. For the case of the change in the amount of carbonyl groups, as an example, it is shown that accelerated methods of determining oxygen groups can be used to study the inhibited oxidation of hard coals.

42163 Oxidation of the polycarboxylic acids of coals with hydrogen peroxide. Kukharenko, T.A. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 29-32(Jan 1977).

An investigation of the polycarboxylic acids obtained by oxidizing weathered lean coal of the Bunguro-Listvyanskoe deposit in the Kuzbass has confirmed the hypothesis of the occurrence of the formation of benzenecarboxylic acids from intermediate acids by an oxidative hydrolytic mechanism. When a mixture of polycarboxylic acids obtained from coal is oxidized with hydrogen peroxide, the concentration of benzenecarboxylic acids rises to 90%.

42164 Measurement of the electrical resistance of anthracites on samples of undisturbed structure by the form-probe method. Posyl'nyi, V.Ya. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 67-72(Jan 1977).

A mathematical formula is given for measuring the electrical resistance of anisotropic bodies, especially anthracites by the four-probe method (with the arrangement of the probes at the corners of a square), which is widely used at the present time, and the first results of measurements on anthracites of various ranks are presented in comparison with the results obtained on powdered samples by the standard method. The advantages of the four-probe method, which automatically excludes contact resistance, are noted.

42165 Application of differential ir spectroscopy to the study of coals. Yares, T.D.; Skripchenko, G.B. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 60-62(Jan 1977).

Differential IR spectroscopy has been applied to the study of the transformation of the structure of coals. The features of the method are discussed and the conditions for the quantitative interpretation of the spectra have been determined.

42166 Electron microscopy of coal constituents. Harris, L.A.; Braski, D.N.; Yust, C.S. (Oak Ridge National Lab., TN). *Microstruct. Sci.;* **5**: 351-357(1977).

Studies of a high volatile bituminous coal (Hvab) have been carried out by means of a 120-kV scanning transmission electron microscope (STEM) equipped with an energy dispersion unit for elemental analyses. Sub-micron size minerals intimately associated with the organic matrix were located and identified by means of both elemental and electron diffraction analyses performed on the same particle. Particles as small as 200A in diameter were analyzed. Elemental mapping across apparently homogeneous regions observed in the electron microscope image revealed mineralogical differences within these features.

42167 Error of determination of ash content of coal by the method of X-ray transmission and X-ray and beta scattering. Burek, R. *Przegl. Gorn.;* **32**: No. 11, 504-507(1976). (In Polish).

The accuracy of determination of ash content of coal by radiometric method based on absorption and X-ray radiation scattering with 60 keV and on beta radiation was determined. The tests were carried out on coal samples taken from different areas of the Upper Silesian Coalfield. The differences between determination by the orthodox method and the respective radiometric method were taken as a measure of accuracy. It was found that in the case of the method based on beta particle scattering the differences range from 0.3 to 3.3% of ash, while in the case of methods based on the use of X-ray radiation they range from 0.4 to 17%. The variable iron content of coal is a factor which reduces the accuracy of methods using the X-ray radiation.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42134, 42642, 42646, 43191, 43192

42168 (FE—2549-14) **Development of potential uses for the residue from fluidized bed combustion processes. Technical progress report for month of January 1978.** Minnick, L.J. (Minnick (L.J.), Inc., Plymouth Meeting, Pa. (USA)). 1978. Contract EF-77-C-01-2549. 15p. Dep. NTIS, PC A02/MF A01.

Activity involved characterization of newly received FBC residue material, evaluation of hydrated FBC residue, and studies of several different possible applications for FBC by-products. These applications include stabilized road base compositions, use in hydraulic cement mixtures, production of concrete masonry units, and as aggregate in bituminous paving. Initital studies of the handling and stockpiling behavior of FBC residue for disposal purposes are also discussed.

42169 (PB—272678) **Reclamation of surface mined coal spoils. Final report.** Barnhisel, R.I. (Kentucky Univ., Lexington (USA). Agricultural Experiment Station). Aug 1977. 69p. NTIS PC A04/MF A01.

Field experiments were established in western Kentucky on four types of surface-mined coal spoils. These areas were selected to represent the extremes in spoil materials commonly encountered in reclamation. This report presents evidence that mine spoils may be successfully reclaimed when proper levels of fertility have been restored. With the provision for retaining rainfall on the spoils, yields of mixed legume-fescue forage exceed 4 metric tons per hectare (2 T/acre). These yields are equal to or greater than those of adjacent non-mined land. The advantage of a rough surface created by ripping or subsoiling was obtained at all levels of applied phosphorus. It was found that phosphorus and water are more commonly the limiting factors in obtaining an adequate degree of vegetative cover and associated forage yield than the acidic nature of spoils. However, in acidic spoils lime must be incorporated in order to effectively improve the growing conditions.

42170 (PB—272760) **Soda ash treatment of neutralized mine drainage. Final report, June 1970—December 1975.** Long, D.A.; Butler, J.L.; Lenkevich, M.J. (Gwin, Dobson, and Foreman, Inc., Altoona, Pa. (USA)). May 1977. 76p. NTIS PC A05/MF A01.

Utilization of acid mine drainage (AMD) streams as a source of potable and industrial water has become a major goal of several proposed AMD treatment schemes. From among the various schemes available, the lime neutralization/soda ash softening process was selected for use at Altoona, Pennsylvania. The treatment plant, as constructed, has the capability of treating waters from Kittanning Run (acid mine polluted) alone or in combination with waters from other city sources to achieve: (1) neutralization and iron removal to levels satisfactory for stream release, (2) softening to approximately 100 mg/l $CaCO_3$ hardness for municipal use, and (3) softening to a hardness of 200 mg/l $CaCO_3$ or higher to meet industrial use requirements. The objective of this study was to evaluate the technical and economic feasibility of softening neutralized AMD waters by means of the cold lime/soda ash process. The study was conducted full-scale at the Altoona Treatment Plant located near the Horseshoe Curve area of Altoona, Pennsylvania. Unit processes employed at the plant consisted of lime neutralization, aeration, settling, soda ash softening, recarbonation, and filtration.

42171 (PB—272768) **Reducing methane in coal mine gob areas with vertical boreholes. Final report.** Mazza, R.L.; Mlinar, M.P. (Continental Oil Co., Morgantown, W.Va. (USA)). Feb 1977. Contract H0322851. 146p. NTIS PC A07/MF A01.

This final report on methods of reducing and controlling methane in coal mine gob areas indicates that vertical degas holes are beneficial to the mines of northern West Virginia working the Pittsburgh Coal. The project involved the drilling and testing of eight vertical holes (four over longwall panels and four over room and pillar panels) based on a review of 13 previously in existence. Areas of observation included gas production history, flow entry profile, underground methane reductions, strata separations, and casing loads (accompanying subsidence). Observations led to the drilling of successful holes drilled short of the mine. Eleven gas production response to applied vacuum tests were conducted at nine degas holes under the contract. Significant production responses were recorded over longwall gobs.

42172 (PB—272986) **SO2 abatement for stationary sources in Japan. Final task report, March 1976—August 1977.** Ando, J.; Laseke, B.A. (Chuo Univ., Tokyo (Japan)). Sep 1977. Contract EPA-68-01-4147. 206p. NTIS PC A10/MF A01.

The report describes the status of SO2 abatement technology for stationary sources in Japan as of June 1976. It presents the current status of desulfurization technologies including hydrodesulfurization of oil, decomposition of residual oil, gasification of coal and oil, and flue gas desulfurization (FGD). It examines the major Japanese FGD processes with respect to their applications, performance, economics, major technical problems, developmental status, byproducts, and raw materials. It also contains background information on energy usage, fuel resources, ambient concentration of pollutants, and emission regulations in Japan. It describes processes for the simultaneous removal of SOx and NOx from flue gases. It presents a comparative evaluation of flue gas cleaning technologies in the U.S. and Japan.

42173 (PB—273236) **Emission control in an expanding industry: trace metals from coal combustion. Final report, 1970—1976.** Friedlander, S.K. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd); California Inst. of Tech., Pasadena (USA)). Dec 1976. 14p. NTIS PC A02/MF A01.

There is evidence that submicrometer aerosols emitted from coal-fired power plants are enriched in trace metals of public health concern. Electrical precipitators, which are used to control these particles, exhibit an efficiency minimum in the 0.1 to 1.0 micrometer size range. If a significant fraction of the mass of an undesirable chemical species occurs in a size range in which the collection efficiency is low, large increases in precipitator capacity or power input per unit of gas treated will be required to control the related emissions. The increases in capacity will be much greater than those estimated on the basis of the usual 99+% efficiencies reported on a weight basis. An alternative to modifying precipitator design is to reduce the accumulation of undesirable chemical species in that particle size range in the combustion and post-combustion zones. To be regarded as a viable alternative, this would require basic research into the fundamentals of coal particles combustion followed by practical field experiments.

42174 (PB—273470) **Feasibility study of utilization of coal mine refuse, Estill County, Kentucky. Final report.** (Kentucky Univ., Lexington (USA). Research Foundation). Aug 1976. 307p. NTIS PC A14/MF A01.

Reported is a feasibility study of commercial utilization for Eastern KY coal mine refuse at the South-East Coal Co. Cleaning plant in Estill County, KY. Included are descriptions of the physical facilities, sampling and testing methodology, geotechnical properties analyses, typical coal analyses, mineralogical characterizations, slow and quick firing test results, general marketing review of products, and environmental aspects. A good potential for economic development in Estill County exists with the anticipated uses of coal mine refuse as a raw material for the production of construction materials, particularly sintered lightweight aggregate. The refuse responded to the sintering process and a high quality, lightweight product was produced. The aggregate performed well in structural concrete and bituminous surfacing mixes. Other potential uses would be for lightweight concrete masonry blocks and soilless growing media. Inherent characteristics of the sintered material would provide for highly skid-resistant road surfacing aggregate and highly insulative structural building products. Market research results point to definitely feasible markets in East and East-Central KY and to the need for extensive, intensive marketing programs for commercial success of the proposed products. (Portions of this document are not fully legible)

42175 (PB—273497) **Source testing of a stationary coke-side enclosure. Great Lakes Carbon Corporation, St. Louis, Missouri plant. Volume I.** Mutchler, J.E.; Loch, T.A.; Cooper, F.I.; Vecchio, J.L. (Clayton Environmental Consultants, Inc., Southfield, Mich. (USA)). 31 Aug 1977. Contract EPA-68-02-1408. 120p. NTIS PC A06/MF A01.

This report summarizes a study of coke-side emissions at three coke-oven batteries producing foundry coke at Great Lakes Carbon Corporation (GLC) in St. Louis, Missouri. Of the three batteries, the south battery 'A' is equipped with the coke-side shed. The center battery 'B' and the north battery 'C' were not equipped with a functional shed at the time of the study. Objectives of this study were to develop: (1) Basic engineering data concerning process emissions, fugitive emissions from the shed, capture efficiency of the shed, and quantity and characteristics of contaminants present in the shed exhaust; (2) Other basic engineering data for specification of future retrofitted control devices for removal of air contaminants in the shed exhaust; and (3) Correlations to relate these measurements to process conditions.

42176 (PB—273498) **Source testing of a stationary coke-side enclosure. Great Lakes Carbon Corporation, St. Louis, Missouri plant. Volume II.** Mutchler, J.E.; Loch, T.A.; Cooper, F.I.; Vecchio, J.L. (Clayton Environmental Consultants, Inc., Southfield, Mich. (USA)). 31 Aug 1977. Contract EPA-68-02-1408. 151p. NTIS PC A08/MF A01.

Volume 2 contains the appendices. Titles are as follows: Emission measurement project participants; Pushing-cycle particulate test results; Non-pushing-cycle particulate test results; Particle size distribution data; Emission results of gases and other materials; Sampling summary sheets; X-ray fluorescence spectrometer analysis of coke-side particulate emissions; Microscopic analysis of coke-side particulate emissions; EPA report of continuous opacity measurements using a transmissometer.

42177 (PB—274858) **Design guide for metal and nonmetal tailings disposal. Information circular.** Soderberg, R.L.; Busch, R.A. (Bureau of Mines, Spokane, Wash. (USA). Spokane Mining Research Center). 1977. 144p. (BM-IC—8755). NTIS PC A07/MF A01.

The Bureau of Mines has conducted considerable research on the design, construction, and operation of metal and nonmetal tailings ponds. This design guide and other related Bureau publications that preceded it are produced to assist the industry in the management of mill tailings disposal. It covers the site selection, sampling, laboratory testing, design, construction, operation and inspection of tailings embankments. The effects of environment, topography, and hydrogeology are also included. A review of various methods of stability analysis and factors affecting stability are presented. Because of the diversity of problems encountered in tailings embankments, specific solutions are not intended. The guide is, however, a useful checklist for designers, operators, and inspectors of this type of structure.

42178 **Performance of slurry and trickle-bed reactors: application to sulfur dioxide removal.** Goto, S. (Nagoya Univ., Japan); Smith, J.M. *AIChE J.;* **24**: No. 2, 287-293(Mar 1978).

Methods are developed for predicting the performance of different types of three-phase reactors for removal of a gaseous reactant by catalytic reaction. The removal is assumed to occur by mass transport of reactant from gas-to-liquid and liquid-to-catalyst particle and then by intraparticle diffusion and reaction in the liquid filled pores. The method is applied to the oxidation of sulfur dioxide at 25°C and 1 atm using activated carbon, in the presence of water, as a catalyst. Slurry, trickle-bed, and counterflow packed-bed reactors are compared in terms of the key variables affecting the fraction of sulfur dioxide reacted.

42179 **Experience in treating waste waters from the Donetsk mines.** Solov'er, V.I. *Gig. Sanit.;* No. 3, 95-97(1977). (In Russian).

Means of treating the 173,000 m^3 daily waste water discharge containing bacteria from the Donetsk coal mines into the open reservoir of the city of Donetsk are described. In the past 10 years an extensive project has been completed to replace horizontal settling basins with fountain ponds, rock filters, underground pressurized sand filters with electrolysis and an electrodialysis installation. Laboratory tests carried out between 1962 and 1973 indicated substantial progress in reducing suspended particles in the Donetsk discharge waters.

42180 **Features of the interaction of alumina and silica with carbon-containing reducing agents.** Kondratenko, A.P. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **10**: No. 5, 59-62(1976).

In the mining of Ekibastuz coals, a rock containing 35 to 49% of coal substance and 60 to 65% of mineral fractions, mainly silica and alumina, is sent to the waste dump. When this rock is heated in an inert atmosphere above 1500 C the alumina and silica are reduced by the carbon present, as a result of which, in prinicple, it is possible to obtain a number of valuable products. These reactions are discussed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42118, 42168, 42169, 42190, 42636, 43559, 43574, 43575, 43596, 43605, 43606, 43612, 43650

42181 (ANL/LRP—2) **Land reclamation program. Annual report, July 1976—October 1977.** Carter, R.P.; Hinchman, R.R.; Johnson, D.O. (Argonne National Lab., Ill. (USA)). May 1978. Contract W-31-109-ENG-38. 171p. Dep. NTIS, PC A08/MF A01.

The Argonne Land Reclamation Program, sponsored by the United States Department of Energy's Division of Environment and Safety, is a joint effort of two Argonne divisions: Energy and Environmental Systems and Environmental Impact Studies. The program is carried out by a multidisciplinary team of scientists and engineers, and has three primary goals: (1) to conduct research and development projects that are focused on both near- and far-term reclamation problems in all major U.S. coal regions; (2) to coordinate and evaluate related studies at other institutions; and (3) to keep industry and government decision-makers informed of reasonable reclamation options and their costs. Since many of the factors that influence reclamation success are region- or site-specific, the program has adopted a regional approach to field and laboratory research. In each of the nation's eight major coal regions, one or more mines have been (or will be) selected as sites for field studies. The vast amount of data gathered by the research arm of the program has also required the development of a data systems component of the program. This annual report is intended to provide a summary of the program's activities and accomplishments during fiscal year 1977.

42182 (CONF-780213—6) **Water quality implications of increase coal use.** Habegger, L.J.; Chiu, S.Y.; Dauzvardis, P.A.; Gasper, J.R.

(Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 107. AIME meeting; Denver, CO, USA (26 Feb 1978).

This paper considers the potential water quality impacts of future energy scenarios which project an approximate doubling of coal utilization from 1975 to 1985. The major impacts estimated for coal extraction are related to effluents from unregulated activities (reclaimed areas prior to stable revegetation) and pollutants (e.g., metals and ammonia). Where applicable, the EPA effluent guidelines to be in effect by 1983 reduce the impact of individual sources to low levels. For example, total suspended solids and acidic discharges are to be regulated to levels generally below recommended water quality standards for receiving streams. However, implementation of these guidelines, particularly for coal extraction, has not been demonstrated on a wide scale. Water quality is not expected to be a major constraining factor for increasing capacity of coal fired utility and industrial boilers. Water quality control has not been demonstrated on a commercial scale for coal conversion to synfuels, but adequate control technologies appear to be feasible.

42183 (PB—273017) **Impact of energy development on water resources in the Upper Colorado River Basin. Completion report.** Flug, M.; Walker, W.R.; Skogerboe, G.V.; Smith, S.W. (Colorado State Univ., Fort Collins (USA). Dept. of Agricultural Engineering). Aug 1977. Contract DI-14-31-0001-5211. 159p. NTIS PC A08/MF A01.

The Upper Colorado River Basin contains appreciable amounts of undeveloped coal, oil shale, and uranium resources, which are important in the national energy demand system. A mathematical model, which simulates the salt and water exchange phase of potential fuel conversions, has been developed, based on a subbasin analysis identifying available mineral and water resources. Potential energy developments are evaluated with respect to the resulting impacts upon both the quantity and salinity of the waters in the Colorado River. Model solutions are generated by use of a multilevel minimum cost linear programming algorithm, minimum cost referring to the cost of developing predetermined levels of energy output. Level one in the model analysis represents an aggregation of subbasins along state boundaries and thereby optimizes energy developments over the five states of the Upper Colorado River Basin. In each of the five second level problems, energy developments over a subbasin division within the respective states are optimized. Development policies which use high salinity waters of the Upper Colorado River enable a net salinity reduction to be realized in the Colorado River at Lee Ferry, Arizona.

42184 (PB—274843) **Environmental assessment data base for low/medium-Btu gasification technology: Volume II. Appendices A-F. Final task report Aug 76—Jun 77.** Cavanaugh, E.C.; Corbett, W.E.; Page, G.C. (Radian Corp., Austin, Tex. (USA)). Nov 1977. Contract EPA-68-02-2147. 367p. NTIS PC A16/MF A01.

The report represents the current data base for the environmental assessment of low- and medium-Btu gasification technology. Purpose of the report is to determine: processes that can be used to produce low/medium-Btu gas from coal, uses of the product gas, multimedia discharge streams generated by the processes, and the technology required to control the discharge streams. Attention is on the processes that appear to have the greatest likelihood of near-term commercialization. This type of screening provides the preliminary basis for establishing priorities for subsequent phases of the low/medium-Btu gasification environmental assessment program. Processes required to produce low/medium-Btu gas from coal are divided into discrete operations: coal pretreatment, gasification, and gas purification. Each operation is divided into discrete modules, each having a defined function and identifiable raw materials, products, and discharge streams. This volume includes appendices that contain detailed process, environmental, and control technology data for the processes considered to have the greatest potential for near-term commercialization.

42185 (PB—274844) **Environmental assessment data base for low/medium-Btu gasification technology: Volume I. Technical discussion. Final task report Aug 76—Jun 77.** Cavanaugh, E.C.; Corbett, W.E.; Page, G.C. (Radian Corp., Austin, Tex. (USA)). Nov 1977. Contract EPA-68-02-2147. 171p. NTIS PC A08/MF A01.

The report represents the current data base for the environmental assessment of low- and medium-Btu gasification technology. Purpose of the report is to determine: processes that can be used to produce low/medium-Btu gas from coal, uses of the product gas, multimedia discharge streams generated by the processes, and the technology required to control the discharge streams. Attention is on the processes that appear to have the greatest likelihood of near-term commercialization. This type of screening provides the preliminary basis for establishing priorities for subsequent phases of the low/medium-Btu gasification environmental assessment program. Processes required to produce low/medium-Btu gas from coal are divided into discrete operations: coal pretreatment, gasification, and gas purification. Each operation is divided into discrete modules, each having a defined function and identifiable raw materials, products, and discharge streams. This volume includes a discussion of the status, significant trends, major process operations, multimedia discharge stream control strategies, and recommendations for future program activities.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 42218

42186 (N—78-11454) **Nucleonic coal detector with independent, hydropneumatic suspension. Final report.** Jones, E.W.; Handy, K. (Mississippi State Univ., Mississippi State (USA). Dept. of Mechanical Engineering). 10 Jun 1977. Contract NAS8-32214. 49p. (NASA-CR—150465). NTIS PC A03/MF A01.

The design of a nucleonic, coal interface detector which measures the depth of coal on the roof and floor of a coal mine is presented. The nucleonic source and the nucleonic detector are on independent hydropneumatic suspensions to reduce the measurement errors due to air gap.

42187 **Coal logging system.** Givens, W.W. (to Mobil Oil Corp.). US Patent 4,066,892. 3 Jan 1978. Filed date 16 Aug 1976. 6p.

A borehole logging tool employs two neutron sources of differing energy outputs, two gamma-ray detectors, and a neutron detector in the radioactivity logging of a coal-bearing formation. A first of the gamma-ray detectors measures the gamma rays produced by the formation in response to the higher energy neutron source. A second of the gamma-ray detectors measures the gamma rays produced by the formation in response to the lower energy neutron source. The neutron detector measures thermal or epithermal neutrons produced by the formation in response to the neutron sources. These measurements are selectively transferred to a recording system employing a plurality of energy level discriminators, count rate meters, and comparators. The recording system, in response to these measurements, provides output signals representative of the carbon, sulfur, ash, and neutron moderating power of the coal in the formation being logged. The carbon and neutron moderating power provide a means of measuring the energy content of coal.

MINING

REFER ALSO TO CITATION(S) 42216, 42218, 42220, 42221

42188 (E—78-10032) **The application of LANDSAT-1 imagery for monitoring strip mines in the New River watershed in northeast Tennessee. Part 2. Final report.** Shahrokhi, F.; Sharber, L.A. (Tennessee Univ., Tullahoma (USA). Space Inst.). 1977. Contract NAS8-31980. 81p. NTIS PC A05/MF A01.

The author has identified the following significant results. LANDSAT imagery and supplementary aircraft photography of the New River drainage basin were subjected to a multilevel analysis using conventional photo-interpretation methods, densitometric techniques, multispectral analysis, and statistical tests to determine the accuracy of LANDSAT-1 imagery for measuring strip mines of common size. The LANDSAT areas were compared with low altitude measurements. The average accuracy over all the mined land sample areas mapped from LANDSAT-1 was 90%. The discrimination of strip mine subcategories is somewhat limited on LANDSAT imagery. A mine site, whether active or inactive, can be inferred by lack of vegetation, by shape, or image texture. Mine ponds are difficult or impossible to detect because of their small size and turbidity. Unless bordered and contrasted with vegetation, haulage roads are impossible to delineate. Preparation plants and refuge areas are not detectable. Density slicing of LANDSAT band 7 proved most useful in the detection of reclamation progress within the mined areas. For most state requirements for year-round monitoring of surface mined land, LANDSAT is of limited value. However, for periodic updating of regional surface maps, LANDSAT may provide sufficient accuracies for some users.

42189 (ORAU—141) **Coal mine labor productivity: the problem, policy implications, and literature review.** Baker, J.G. (Oak Ridge Associated Universities, Inc., Tenn. (USA)). Apr 1978. Contract EY-76-C-05-0033. 36p. Dep. NTIS, PC A03/MF A01.

Coal mining productivity in the USA increased dramatically between 1950 and 1969; (from 6.79 to 19.90 tons per shift worker) between 1969 and 1976, productivity declined by one-third and the average cost per ton of coal increased fourfold. Hypothetical causes for the decrease in productivity are presented and further work on ascertaining the major causes and on the implications of these for energy policy are recommended. The uncertainties involved in fore-

casting productivity make it very difficult to estimate the manpower required to meet the President's 1985 production target. (LTN)

42190 (PB—272896) **Elkins mine drainage pollution control demonstration project. Final report 1964—1967.** (PEDCO-Environmental, Inc., Cincinnati, Ohio (USA)). Aug 1977. Contract EPA-68-02-1321. 316p. NTIS PC A14/MF A01.

In 1964 several federal agencies in cooperation with the State of West Virginia initiated a project to demonstrate methods to control the pollution from abandoned underground and surface mines in the Roaring Creek-Grassy Run Watersheds near Elkins, West Virginia. The Roaring Creek-Grassy Run watersheds contained 400 hectares of disturbed land, 1200 hectares of underground mine workings and discharged over 11 metric tons per day of acidity to the Tygart Valley River. The reclamation project was to demonstrate the effectiveness of mine seals, water diversion from underground workings, burial of acid-producing spoils and refuse, surface mine reclamation, and surface mine revegetation. Following a termination order in 1967, major efforts were directed away from the completion of the mine sealings and toward surface mining reclamation and revegetation. In July 1968 the reclamation work was completed with the reclamation and revegetation of 284 hectares of disturbed land and the construction of 101 mine seals. Results of an extensive monitoring program revealed that some reduction in acidity load (as high as 20 percent during 1968 and 1969), and little if any in iron and sulfate loads and flow have occurred in Grassy Run. Roaring Creek had an insignificant change in flow as a result of water diversion, and a decrease of 5 to 16 percent in acidity and sulfate load. Biological recovery in both streams has been nonexistent except in some smaller subwatersheds. Good vegetative cover has been established on almost all of the disturbed areas. Legumes dominate in most areas after eight years.

42191 (PB—274702) **Physical and chemical characteristics of available materials for filling subsurface coal mines. Final report.** Dunn, J.R.; Banino, G.M.; Ernst, W.D. (Dunn Geoscience Corp., Latham, N.Y. (USA)). Jun 1977. Contract J0155182. 282p. NTIS PC A13/MF A01.

Samples were taken of industrial mineral waste materials which are potentially capable of being used for filling underground coal mines for subsidence control in the Pittsburgh and the Scranton-Wilkes Barre areas of Pennsylvania. The samples were subjected to potentially relevant standard tests which are commonly used in the evaluation of soil materials and mineral aggregate materials. Measurements of plasticity, liquid limit, and gradations, particularly in the -200 mesh size range, indicated a comparative lack of clay minerals. Cementitious reactions between sources of alkali, such as calcium hydroxide or portland cement stack dust, and of silica, such as clay or fly ash, were found to occur in various mixes of high-bulk materials. The possibility of emplacement of high-bulk material by both turbid flow (or density currents) below water and by mud flows above water were considered and both appear to be reasonable and possibly simpler than the current mechanisms of emplacement.

42192 (PB—274796) **Analysis of job stress in coal mining.** Althouse, R.; Hurrell, J.J. Jr. (West Virginia Univ., Morgantown (USA). Dept. of Sociology and Anthropology). May 1977. 145p. NTIS PC A07/MF A01.

A sample of 486 miners and mine foremen was investigated via a questionnaire to determine whether job stresses would be a real hazard to their psychological well-being. Evidence indicated that job stresses clustered together and had identifiable effects on responses among miners. When compared with a national occupational sample in which a cluster of stressors among low status jobs have been identified, miners reported no greater job stress, but indicated significantly more affective strains - anxiety, depression, irritation, somatic complaints - than workers in a number of other blue collar jobs. Among miners, perceived stressors and work load features were reflected in the relationship between conflicting role demands and relations with supervisory personnel. Poor relations with foremen and conflicting role demands fed dissatisfaction and encouraged worker discontentment. Results also showed that underground coal miners reported a substantial amount of strain, and those who did were more likely to report problems with their health.

42193 (PB—274900) **Coal pillar strength study. (The design of production pillars in coal mines). Final report Jun 74—Jun 77.** Pariseau, W.G.; Hustrulid, W.A.; Swanson, S.R.; Van Sambeek, L.L. (Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering). Jul 1977. Contract H0242059. 422p. NTIS PC A18/MF A01.

Laboratory tests for unconfined compressive strength and Young's modulus on 371 test cylinders of coal at length to diameter ratios of 1/2, 1, 1-1/2, and 2, and nominal diameters of 1, 2, 4, 6, 8, and 12 inches are reported. Linear regression of ultimate strength Cu on diameter to height ratio D/L results in the equation Cu(psi) = 4219(0.422(D/L) + 0.578). Finite elements analyses of the laboratory tests using flaw-free geologic materials result in C = C1(0.61D/L + 0.39) and C = C1(0.04D/L + 0.96) using linear and quadratic failure criteria. Field measurements at 117 closure pin stations and 119 vibrating wire stress gage sites in the vicinity of two 60- by 60-foot test pillars separated by 20-foot entries and crosscuts show approximately 1 to 2 inches closure and 2,000 to 4,000 psi stress change prior to mining of the pillars to failure. Finite element analysis of the test section from development through pillar mining and retreat using laboratory rock properties as input shows good agreement with the measured closures. (Portions of this document are not fully legible)

42194 (PB—275240) **Longwall-caving mining method for thick coal. Design and feasibility study. Volume I. Final report.** Wallis, M.G.; Reeves, P.G.; Henneuse, D.P.; Winters, C.W.; Rusconi, J.B. (FMC Corp., Santa Clara, Calif. (USA). Engineered Systems Div.). Mar 1977. Contract J0155010. 425p. NTIS PC A18/MF A01.

This report presents the results of a study to develop a detailed mining method design based on longwall mining with sublevel caving. The method is applicable to low-dipping coal seams 20 feet or more thick such as are found in the western United States. The report covers the development and description of the mining method, the evaluation of the engineering feasibility of the design, estimates of productivity and recovery, and an engineering cost analysis and economic feasibility evaluation of the mining method design. (Color illustrations reproduced in black and white)

42195 **Air injection technique for investigating the integrity of pillars and ribs in coal mines.** Barron, K. (Coal Mining Research Centre, Edmonton, Alberta). *Int. J. Rock Mech. Min. Sci. Geomech. Abstr.;* **15**: No. 2, 69-76(Apr 1978).

A simple, inexpensive and relatively quick air injection technique is described. The test is based on the principle that when pressurized air is injected into coal, the rate of air leakage will be greater in fractured or stress-relieved coal than in relatively competent or highly-stressed coal. The apparatus consists of a constant volume container from which air is released under pressure into a sealed measuring section of a borehole drilled into the coal rib or pillar. The rate of air pressure decay is timed and an absolute fracture index, is derived which is inversely proportional to the coal permeability. This test was used to examine the integrity of a number of coal pillars and rib sides in several coal mines. It was shown that the test will clearly indicate the peripheral fracture zone around the pillar, the high stress abutment zones in the pillar and a relatively undisturbed zone of coal in the centre of the pillar. The variation of the absolute fracture index across a pillar usually has the same shape as the anticipated theoretical stress distribution. An exception to this shape was noted where the pillar was cut by a number of fracture sets which were believed to have existed prior to formation of the pillar. A pillar "integrity" index is also defined as the percentage of the area of the "solid central core" of the pillar to the total pillar area. The pillar integrity index was shown to vary with time, and it is speculated that this index may have some relationship to the bearing capacity of the pillar.

42196 **Radial mining method.** Roye, H.L. US Patent 4,072,351. 7 Feb 1978. Filed date 24 Jan 1977. 10p.

A method of mining a large underground seam of mineral such as coal is described in which a first cylindrical shaft is drilled from the surface of the earth down to the mineral seam. A portion is enlarged at the base of the first shaft as a work room. A first radial shaft out to a selected radius R is drilled by conventional methods with the roofs supported by means such as hydraulic chocks which can be extended and moved selectively as the line of drilling progresses. When the first shaft is drilled a continuous miner working on a short face method of mining is directed radially from the work room and is advanced outwardly until the width of the first radial shaft is such that the original wall of the first shaft has been cut away. The direction of the miner is then turned to be parallel to the first horizontal shaft and a short wall cutting advance is made to cut away the first wall of the first shaft and in effect drill a second shaft having a first wall spaced by the width of the cutter. A continuous flexible curtain is provided between the floor and roof on the back side of the chocks so that fresh air can be brought down through the vertical shaft and radially outward toward the working face and back on the outside of the flexible curtain toward the working room and up to the surface in a second vertical slope shaft.

42197 **Longwall machine guide with detachable cover plate.** Peters, W.; Hauschopp, A.; Merten, G. (to Gewerkschaft Eisenhutte Westfalia). US Patent 4,067,619. 10 Jan 1978. Priority date 10 Sep 1975, German, Federal Republic of (F.R. Germany). 8p.

A guide for a mining machine, such as a plough, is constructed from a series of interconnected sections arranged end-to-end and secured with bolts to the mineral face side wall of a conveyor. Each guide section is composed of an L-shaped plate with an upstanding wall engaging on the conveyor side wall and an inclined foot wall supporting the body of the plough. Spacers locating the securing bolts separate upper and lower chain guide passages and a cover

plate extends over the mineral face side of the passages. A slot is formed above the foot wall to allow the plough body to be coupled to the chain in the lower passage. The slot is defined at its upper side by channel-like strips assembled to the spacers and these strips have apertures which receive tongues on the cover plate to thereby form a detachable push-in hinge permitting the cover plate to pivot towards the mineral face. The cover plate is detachably secured to the L-shaped plate at its upper end.

42198 Australian mining yearbook 1976. Chippendale, Australia; Thomson (1976). 138p.

This yearbook contains information on mining industry statistics, mine location maps, major hard rock mining companies, directory of directors, overseas mining companies operating in Australia, coal mining companies, consultants to the industry, service companies, buyers' guide, government departments concerned with mining, universities and learned organizations concerned with mining, research organizations, mining industry organizations, smelters and refiners, and cement manufacturers.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 42116, 42160, 43378, 43421

42199 (IS—4283) **Coal benefication program review.** (Ames Lab., Iowa (USA)). 9 Nov 1977. Contract W-7405-ENG-82. 14p. Dep. NTIS, PC A02/MF A01.

This report is written to acquaint DOE personnel with the coal beneficiation program of the Ames Laboratory, Iowa State University. It appears that the involvement of the Laboratory in this area is not widely known, probably owing to the fact that much of the work performed here and the facilities developed here were initiated with state, rather than federal, support as part of the Iowa Coal Project. At this time, however, the Laboratory has committed itself to participation in a continuing and substantial fossil energy effort, much of which is integrated with and dependent upon a growing program in coal beneficiation. In order to sustain and encourage this program growth to help meet national energy needs, support and cooperation from the Department of Energy are essential. The program, physical facilities, analytical services, and personnel are described briefly.

42200 (PB—273425) **Montana's major energy transportation systems: current conditions and future developments.** (Montana Energy Advisory Council, Helena (USA)). Dec 1976. 111p. NTIS PC A06/MF A01.

This report discusses major energy transportation systems in Montana, future developments in Montana's coal-related transportation systems, and proposals to supply petroleum and natural gas to Montana.

42201 Apparatus and method for separating a mixture of liquid and coal fines. Aktay, A.I.; Bodnaruk, B.J.; Holowaty, M.O. (to Inland Steel Co.). US Patent 4,065,385. 27 Dec 1977. Filed date 13 Dec 1976. 8p.

Coal fines are separated from a mixture containing liquid and coal fines in an apparatus comprising a combination surge tank and flotation tank employing air bubbles to urge the coal fines toward the overflow from the flotation tank.

42202 Coal slurry feeder. Doerr, R.E. (to Continental Oil Co.). US Patent 4,060,281. 29 Nov 1977. Filed date 10 Nov 1976. 4p.

A feeder apparatus for transferring particulate material and water from a sump outlet to the inlet of a pump is formed in the sump by making a well at the outlet of the sump and placing an impeller in the well. A partition is formed separating the inlet to the feeder from its outlet, the partition having a height equal to or exceeding that of the water level in the sump. The outlet from the sump is connected to a channel which has a continually decreasing cross-sectional area, the terminus of which is connected to the inlet of the pump. A fluid jet can be mounted at the inlet of the feeder for reducing the concentration of particulate fluids at the pump inlet or for fluidizing the particles at the entrance of the pump.

42203 Method and apparatus for coal treatment. Gambs, G.C.; Morgan, H.P. (to Ford, Bacon and Davis, Inc.). US Patent 4,059,060. 22 Nov 1977. Filed date 29 Mar 1976. 10p.

Method and apparatus are disclosed for upgrading subbituminous coal and/or lignite fuel product that does not comply with an applicable SO/sub x/:Btu standard during the combustion thereof. The fuel product is treated at the combustion site to lower the total moisture content thereof from between about 15 and 45% to between about 4 and 7%. Heavier weight ash particles are removed from the fuel product to lower the sulfur content thereof. The treated fuel product is burned while it is in the 4 to 7% total moisture range, thereby meeting the applicable SO/sub x/:Btu standard during the combustion process.

42204 Method for producing fuel briquettes. Goossens, W.; Hermann, W.; Keusch, W.; Redlich, R. (to Eschweiler Bergwerks-Verein Aktiengesellschaft). US Patent 4,059,412. 22 Nov 1977. Priority date 4 Jun 1975, German, Federal Republic of (F.R. Germany). 6p.

Fuel briquettes are produced by hot pressing a mixture of a fine grained coal softening at the pressing temperature and a coal component which hardly or not at all softens at the pressing temperature. The starting materials are converted into a granular structure material by the use of pure oxygen or an oxygen/nitrogen mixture having an oxygen content above 21% by volume so that the resulting granular material has a bulk weight of between 0.3 t/m^3 to 0.7 t/m^3.

42205 Influence of the grain-size composition of coal on the properties of aqueous coal suspensions. Rukin, E.I. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 54-59(Jan 1977).

Papers give the results of experiments on the influence of the grain-size composition of hard coal on the rheological properties and stability of suspensions. A regression model of the dependence of the structural viscosity of the suspension on the degree of dispersion and the polydispersion coefficient of the coal has been worked out.

42206 Electrification of an aerosol in the comminution and pulverization of coal. Saranchuk, V.I.; Rekun, V.V. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 63-66(Jan 1977).

The results are given of investigations of the strength of the electrostatic field formed during pulverization of Donbass coals of various ranks. The nature of the influence of the physicochemical properties and state of oxidation of the coal on the parameters of the electrostatic field in a dust aerosol have been established. The chief causes of the electrostatic field are breakdown of the coal substance, the disruption of chemical bonds, or structural alterations in the coal macromolecule.

COMBUSTION

REFER ALSO TO CITATION(S) 42143, 42168, 42218, 43482, 43483, 43484, 43486, 43684

42207 (ANL/CEN/FE—77-10) **Regeneration of sulfated limestone from FBCs and corrosive effects of sulfation activators in FBCs. Quarterly report, October—December 1977.** Vogel, G.J.; Johnson, I.; Lenc, J.F.; Snyder, R.B.; Smyk, E.B.; Teats, F.G.; Jonke, A.A. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

These studies support development work in atmospheric and pressurized fluidized-bed coal combustion. The relative effects of major economic variables on the economic feasibility of the fluidized-bed reductive decomposition process were determined for coals and sorbents for which cyclic combustion and regeneration data are available. Also, a computational method was developed for predicting the cost of a regeneration system when system size, various economic factors, coal type, sorbent type, and preliminary data on sorbent reactivity are given. A new, automated, atmospheric-pressure, 6-in.-dia, fluidized-bed coal combustion facility is being constructed to study the corrosive effects on materials of construction of (1) agents added to the combustor bed materials to accelerate limestone sulfation rate and (2) combinations of sulfation-accelerating agents and corrosion inhibitors.

42208 (BNWL—2100(Pt.4), pp 3-7) **Reaction kinetics of combustion processes.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

The goal is the development of a model which will predict the chemical and physical forms of the gas and particulate emissions at any point past the combustion source, and to predict the chemical reactions which occur before meterological and diffusional considerations dominate. Fly ash has been characterized by electron spectroscopy for chemical analysis (ESCA), x-ray fluorescence and neutron activation. These studies suggest the concept of trace element differentiation, with certain trace elements, being more concentrated at the surface than within the particulate. Since the chemical state of the trace element will often determine its environmental availability and toxicity, a methodology is being developed which can identify sub ppM levels of several valence states of 12 potentially toxic trace elements.

42209 (FE—2516-5) **Centrifugal fluidized combustion of coal. Quarterly report, October—December 1977.** Levy, E.K.; Chen, J.C.

(Lehigh Univ., Bethlehem, Pa. (USA)). Jan 1978. Contract EX-76-S-01-2516. 15p. Dep. NTIS, PC A02/MF A01.

Experiments were performed on the continuous feed and removal of solids, where solids are fed to the bed from a feed nozzle located in the freeboard region of the test section and the material is removed through slots in the bottom end wall of the rotating chamber. The experiments indicate that with these techniques it is possible to feed and remove solids and achieve a stable bed thickness after a transient start-up period. The area of the discharge holes was sufficiently large so that the bed thickness was constant over the entire range of feed rates. Additional work is needed now to determine the influence of discharge geometry on discharge rate. Work is also needed on the solids feed system to determine the effects of location and orientation of the feed nozzle and velocity of the feed stream on solids feeding.

42210 (FE—2689-1) **Investigation of fuels containing coal—oil—water emulsions. First quarterly report, August 24—December 31, 1977.** Cherry, N.H.; Stokes, C.S. (Germantown Labs., Inc., Philadelphia, Pa. (USA)). Jan 1978. Contract EF-77-C-01-2689. 20p. Dep. NTIS, PC A02/MF A01.

The program of this research investigation is to assess the use of commercial emulsifiers to produce stable coal-oil-water emulsions (COMs) and determine the practicability of their use in boiler system. Five emulsifiers will be evaluated. A new method for determining the stability of COMs has been studied and found to be applicable to these investigations. The method involves measuring the dielectric constant of the COM by use of an automatic capacitance measuring system. Viscosity data on the oils to be used in the program have been tabulated.

42211 (HCP/T2637—01) **Industrial and utility applications coal-oil mixture data index.** (McKee (Arthur G.) and Co., Cleveland, Ohio (USA)). May 1978. Contract EX-77-C-01-2637. 268p. Dep. NTIS, PC A12/MF A01.

The seriousness of the present and projected national energy picture dictated the adoption of several approaches by the Department of Energy (DOE) to develop alternate fuel sources as a means of curtailing our present dependence on imported oil. One approach, which offers near term potential for reducing the domestic consumption rate of natural gas and oil, is the application of coal-oil mixture (COM) combustion technology. The idea of burning coal and oil in the form of a mixture has been around for some time and is not viewed by DOE, in any degree, as the solution to our domestic energy problem. However, it is viewed as a near-term retrofit coal utilization technology with a high degree of application potential to existing oil fired systems. In view of this, DOE has undertaken several demonstration and support-research projects to further define existing COM technical uncertainties. The purpose of this manual is to present a comprehensive technical description and status of each project, both informative and practical with respect to the diverse data requirements.

42212 (ORNL/TM—6275) **Corrosion analysis of boiler tubes from a 100-hp boiler burning an oil coal slurry.** Cooper, R.H. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

A corrosion analysis was performed on segments of ASTM A 178 steel boiler tubes removed from a 75-kW boiler operated by the Pittsburgh Energy Research Center. It burned a coal slurry in No. 6 fuel oil and produced 171°C steam. The boiler tubes were exposed to this environment for 1000 h with an operating wall temperature of about 180°C. A 76-μm-thick scale formed on the fire side of these tubes. Exposure of the tubes to atmospheric conditions during boiler disassembly and cyclic boiler conditions prevented estimating the contribution of the flue gas exposure to the scale buildup. However, analysis of this scale indicated that fly ash deposition accounted for less than 5% of the tube weight of the scale.

42213 (PNL—2500(Pt.4), pp 1.1-1.3) **Reaction kinetics of combustion processes.** Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Progress is reported on three topics: formation of fly ash in coal combustion, mass spectrometric studies of combustion-related reactions, and characterization of gases from in-situ coal gasification. (DLC)

42214 **Two stage partial combustion process for solid carbonaceous fuels.** Buiter, P.; van der Burgt, M.J.; Van Helden, H.J.A. (to Shell Internationale Research Maatschappij B.B.). US Patent 4,060,397. 29 Nov 1977. Priority date 21 Feb 1974, United Kingdom of Great Britain and Northern Ireland (UK). 8p.

An improved process for the production of a soot-free hydrogen and carbon monoxide-containing gas by non-catalytic partial combustion of a carbonaceous fuel is described. In this process high yields of hydrogen and carbon monoxide are obtained by staging the partial combustion reaction in a manner such that a substantial portion, e.g., up to 95%, of the carbonaceous fuel charge to the process is reacted with diluted oxygen in a first reaction zone maintained at 1200 to 1700°C to form a first reaction zone effluent made up principally of hydrogen and carbon monoxide and this first reaction zone effluent is passed into a second reaction zone maintained at a temperature at least 100°C lower than the first reaction zone wherein the remaining carbonaceous material is substantially completely converted to gaseous partial combustion products.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42189, 42615, 43126

42215 (ANL/IAPE/TM—78-7) **Potential demand for western coal in the northeastern United States and its relationship to waterway transportation facilities.** Lewis, L.R. (Argonne National Lab., Ill. (USA)). 17 Jan 1978. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

Preliminary studies indicate that a potential exists for the movement of large amounts of Western coal through the Port of Buffalo. In response to increasing interest in Western coal utilization along the southern Great Lakes and in New England, and in consideration for the possible beneficial effects such utilization might have in relieving chronic unemployment problems in the western New York area, the New York area, the New York State Job Development Authority and the Niagara Frontier Transportation Authority have proposed and begun planning for a coal and bulk commodity transshipment terminal to be located at Buffalo. The facility will have the capability of handling 12 million tons per year of Western coal, and will be designed to accommodate unloading and storage for taconite ore, iron ore pellets, and ferro-chromium ores. When completed, Conrail connections will transport coal to inland and lakeside users, with a potential for rail shipment to utilities in Massachusetts and Maine. In terms of potential volumes of coal moving through the system, present informaton indicates that as much as ten million tons per year may be anticipated by 1985. Cost studies indicate that potential savings of up to $4.00 per ton may be realized by New England utilities through the use of Western coals, as opposed to Appalachian coals shipped up the East Coast. The reason lies in lower f.o.b. mine costs for the coal, and higher railroad rates from Appalachian coal fields to East Coast port facilities.

42216 **Report and accounts 1976—1977.** London; National Coal Board (1977). 76p.

Report reviews the activities of the Board in 1976/77: there were increased sales of coal (119.3 M tons); deep mined output decreased, but opencast increased; productivity fell to 43.6 cwts per manshaft overall; a profit of 27.2 M pounds was made; capital expenditure increased; and accident rates were the lowest on record. Coal provides 37.1% of the UK's energy consumption, most being consumed by power stations.

42217 **Steinkohle 1975—1976. (Hard coal 1975—1976).** Essen; Gesamtverband des Deutschen Steinkohlenbergbaus (1976). 90p.

The annual report 1975/76 attempts to take stock of the developments on the world energy market, its big sectoral markets, and on the energy market of the FRG, in particular the German coal market. Consequences are drawn from this balance for the future energy and social policies in mining. Several illustrations elucidate data, developments and prospects for the national and international energy economy.

42218 **Coal: technology for Britain's future.** London; Macmillan (1976). 144p.

The history of the coal industry and its methods and technology are examined. Exploration and proving of fields are discussed. The new type of drift mine is described and the Selby mine is considered in detail, especially with regard to social and environmental aspects. New techniques designed to burn coal more efficiently, such as fluidized bed combustion, are explained.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 43739

REGULATIONS

REFER ALSO TO CITATION(S) 43590

42219 (CONF-7710101—10) **Characteristics and social costs of supplemental high-Btu gas supply options for the Midwest.** Samsa,

M.E. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Supplemental high-Btu gas supply options for the Midwest, each offering nearly equal social benefits, will impact society in a variety of ways and to varying degrees. Comparison of these costs is complicated by lack of a common unit of measure. The trade-offs between dollar costs, public and occupational safety, and environmental impacts, for example, are not straightforward. Further difficulties arise because of changes in the relative ranking of some costs due to reasonable modification in underlying assumptions of future conditions. The consideration of all quantifiable and nonquantifiable social costs, however, is a critical component in future gas supply policy and decision making.

42220 (PB—274696) **Western coal: promise or problem. Agricultural economics research report.** Tyner, W.E.; Kalter, R.J.; Wold, J.P. (Cornell Univ., Ithaca, N.Y. (USA). Agricultural Experiment Station). Aug 1977. 186p. NTIS PC A09/MF A01.

Public policies affecting the disposal of public domain lands for future coal production are examined. The study is divided into two major parts. The first deals with micro or leasehold aspects of coal leasing--factors related to ownership patterns, logical mining units, leasing policies, end uses of coal (and the attendant impacts on fair market value) and intertract competition questions. The second evaluates macro or leasing schedule aspects of western coal development. The pace of leasing through time and its location, as dictated by demand (magnitude and location), transportation economics, geology and production economics (by mining area) is examined. The emphasis is on western surface mining possibilities.

42221 **Hobbling of coal: policy and regulatory uncertainties.** Gordon, R.L. (Pennsylvania State Univ., University Park). *Science;* **200**: No. 4338, 153-158(14 Apr 1978).

The main conclusion reached here is that the costs of restricting coal production and use have been underestimated. A particular concern is that the expenses associated with learning how to comply with new regulations are inadequately considered. In sum, we and our policy-makers are insufficiently aware of how great a conflict exists between proposals for expanding coal use and policies that hobble coal. As a result, we are not making adequate preparations to resolve the problems that may arise.

42222 **More coal now to safeguard our future.** Ezra, D. London; National Coal Board (1977). 12p.

British coal policy is discussed in the light of world events and the energy problem. The Plan for Coal, new projects, and industrial expansion are mentioned and the importance of increasing productivity is stressed.

PETROLEUM

REFER ALSO TO CITATION(S) 42100, 43147

42223 (N—78-11864) **Multi-organizational strategies: an analytic framework and case illustrations.** Davies, C.; Demb, A.; Espejo, R.; Ostrowski, R. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Feb 1977. 33p. (IIASA-RM—77-4). NTIS PC A03/MF A01.

An analytical framework to support organizational strategies for the planning and management of multi-sectoral programs is presented. Two different case studies are reported. The first is concerned with the 'Impacts of Oil Development Offshore of the Northeast Coast of Scotland'. While some findings specific to Scotland are presented, stress is laid on conveying the methodology developed to study the orgranizational dimension of large development programs. This methodology is used in the second case study, the 'Bratsk-Ilimsk Territorial Production Complex', to analyze a particular policy issue presently under consideration by Soviet policy makers, namely, the need for new management mechanisms to support the present evolution of territorial production complexes.

RESERVES

REFER ALSO TO CITATION(S) 43128, 43129

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 42250, 42251, 43751

42224 (PB—273159) **Impact of oil and gas exploration, development, and production on the Outer Continental Shelf on Louisiana: background and methodology.** Farber, S.; Johnson, D.B. (Louisiana State Planning Office, Baton Rouge (USA). Coastal Resources Program; Louisiana Dept. of Conservation, Baton Rouge (USA)). Jul 1976. 159p. NTIS PC A08/MF A01.

This report contains data on OCS development and some financial implications for the state. But the major portion of the study is concerned with alternative methodologies, and their related evaluations, which can be applied to measuring the impact of petroleum and gas mining activity on the Outer Continental Shelf (OCS) adjacent to Louisiana. For purposes of this report the OCS extends seaward from the outer 3 mile limit of the state's jurisdiction to the limit of the continental margin. Chapter 2 contains a survey of the literature. Because the impact methodology proposed is based heavily on the input-output technique, Chapter 3 presents a summary of input-output technology. Chapter 4 summarizes the production and processes of the OCS industry. Chapter 5 presents the methodology for estimating OCS related expenditures and their impact on Louisiana. Chapter 6 is concerned with the methodology of estimating the fiscal impact on Louisiana's governments and Chapter 7 briefly discusses the environmental impact and literature.

42225 (UCRL-Trans—11359) **Determination of effective porosity of upper cretaceous reservoir rocks in the Eastern Ciscaucasus according to data of field geophysics.** Vendel'shtein, B.Yu.; Zoloeva, G.M.; Tsareva, N.V. Apr 1978. Translated from pp 105-116 of Geofizicheskie Issledovaniia Neftynykh i Gazovykh Skvazhin, Moskva, Nedra, 1971. 28p. Dep. NTIS, MF A01.

Portions of document are illegible.

An improved method of determining the secondary porosity of fractured Upper Cretaceous reservoirs form the data of a comprehensive interpretation of electrometry and radiometry logs has been tested using the actual material of one of the fields in the Eastern Ciscaucasus. The need to allow for the content of the insoluble remains of Upper Cretaceous limestones in determining the secondary porosity and effective thickness from data of a comprehensive interpretation of electrometry and radiometry is demonstrated. To estimate the calculated parameters--secondary (effective) porosity and effective thickness--in Upper Cretaceous limestones it is recommended that neutron-gamma logs, resistivity logs, and spontaneous potential logs be used. The use of this alternative version of the method yields higher values of secondary porosity than does the use of data from the comprehensive method of A.M. Nechai.

42226 **Physical and chemical signals around oil and gas traps.** Pirson, S.J. *Log Anal.;* **19**: No. 2, 18-23(1978).

From American Association of Petroleum Geologists 1978 research symposium; Oklahoma City, OK, USA (9 Apr 1978).

Oil and gas reservoirs in the earth are non-equilibrium thermodynamic systems which are never at rest over geologic time. From the early time of precipitation of organic vegetable and animal decay products within the mud and ooze of sediments, migration of organic matter took place in a water-borne transportation process as a result of sedimentary compaction and other diagenetic processes. Entrapment of organic matter in transit is visualized to take place within upward-converging semi-permeable rock strata, the hydrocarbons being retained in one or more subhorizontal spaces therein. A hydrochemical plume is formed in the vertical escape path of the transporting waters. Those ascending waters can produce such effects as mineral alteration by leaching, changes in the redox properties of the rocks, temperature anomalies, residual traces of hydrocarbons, differential compaction, vertical electrotelluric currents, near surface electrical potential sinks, and magneto-electrotelluric effects. The latter will be shown to be of special interest as they are the basis of a versatile oil and gas exploration system bordering on direct oil-finding.

42227 **Biodegradation of oil reservoirs.** Crawford, R.J.; Spyckerelle, C.; Westlake, D.W.S. (Univ. of Alberta, Edmonton). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 3, 204-208(1977).

From Symposium on oil sand and oil shale; Montreal, Canada (29 May 1977).

The effects of microbiological degradation on several conventional pooled oils and on oil sand bitumens were studied. Samples of a Prudhoe Bay (PB) crude were examined for comparison with Lower Cretaceous pooled oils such as Bellshill Lake (BH) and Lloydminster (L1) along with oil sand bitumens from the Cold Lake (CL), Peace River (PR) and Athabasca oil sands. The gas chromatography-mass spectroscopy processes reveal close similarities between the biodegradation products of the oil from Prudhoe Bay and the oil sands and heavy oils of Alberta. A common source for all of these oils is not postulated although they probably share a similar origin and diagenetic history. These results do not give a direct indication as to the maturity and thermal history of the Alberta oil sands but they do support the hypothesis that the oil sands, and some conventional crude oils found in the reservoirs of the Lower Creta-

ceous formation of Alberta share a common origin and are related by their degrees of biodegradation.

42228 Aromatic hydrocarbons: degradation by bacteria and fungi. Cerniglia, C.E.; Gibson, D.T. (Univ. of Texas, Austin). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* 22: No. 3, 209-216(1977).

From Symposium on oil sand and oil shale; Montreal, Canada (29 May 1977).

Aspects of microbial and mammalian degradation of hydrocarbons are reviewed. Bacterial and fungal metabolism are examined. Data are presented indicating that the fungus C. elegans metabolizes naphthalene similar to monooxygenases of hepatic microsomes. There is relatively little information on the microbial degradation of aromatic hydrocarbons when the molecules are present as constituents of crude oil. Nevertheless it is possible that the types of reactions described do occur when microorganisms interact with oil in the environment.

42229 (UCRL-Trans—11358) **First results of deep seismic studies of the Earth's crust in the central part of Western Siberia.** Puzyerv, N.N.; Kondrashov, V.A.; Krylov, S.V.; Potap'ev, S.V. Translated from *Geol. Geofiz.;* No. 11, 82-89(1964). 18p. Dep. NTIS, PC A02/MF A01.

The methods and techniques of regional seismic studies of the earth's crust in the remote central regions of the Western Siberian lowland are presented. The first seismic section of the crust obtained for these regions is offered. The direction of future work is discussed in brief.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 42224

42230 (NP—22930) **China: oil production prospects.** (Central Intelligence Agency, Washington, D.C. (USA)). Jun 1977. 30p. Photoduplication Service, Washington, DC.

China's oil export potential has drawn worldwide attention since the 1973 Arab oil embargo, which coincided with China's first commercial sale of crude oil. Working with limited information, experts in academia, oil companies, and the US Geological Survey generally agree that China's onshore oil reserves are comparable with the 39 billion bbl remaining in the United States. Estimates suggest offshore oil reserves are about the same as those onshore. There are severe financial and technological restraints on increasing Chinese oil production and exports. For 26 years, Peking has forcefed the oil industry with funds and technical manpower. In response, output has grown 20% or more annually, much faster than in the rest of industry. Crude output reached about 1.7 million bbl/d in 1976, comparable with that of Indonesia. Now, however, the rate of growth will certainly decline. The most accessible reserves are being exploited; investment in other industries, especially coal and steel, can no longer be held back to free funds for oil. Moreover, trained manpower is spread thin just to operate the existing industry. Internal conflicts have not allowed the influx of foreign capital and technology needed to rapidly develop offshore reserves. The estimated reserves of 17 to 30 billion barrels in the north and northeast—the regions likely to supply the bulk of output in the short run—would be exhausted in 10 years if output were to continue to grow at the 20% rate. It is believed that China will produce 2.4 to 2.8 million bbl/d by 1980. Most of this oil will be needed for domestic consumption; exports are likely to be only 200,000 to 600,000 bbl/d. Within a decade or so, continuously expanding domestic demand will absorb total capacity unless deposits in the west or offshore are proved and exploited much more rapidly than expected.

42231 Method of production stimulation and enhanced recovery of oil. Whiting, C.R. (to Probe, Inc.). US Patent 4,084,638. 18 Apr 1978. Filed date 16 Oct 1975. 10p.

The present invention relates— to an improved method of recovery of petroleum from presently existing wells which are either non-producing or low production types. The method utilizes surges and oscillations of electrical energy in excess of 150 kilovolts involving the use of heavy current flow over a carbonaceous path in order to establish heat, electrical and physical shock, and steam fracturing (or shattering) within certain sedimentary rock formations, thereby giving rise to an increase in the effective well and reservoir radius both within an existing well and between wells. The method involves the use of a minimum of two existing wells, one being an injection well and the other being a production or recovery well. In each well, insulated high voltage cable is secured within the well casing in order to feed required electrical energy into a probe rod which, at the bottom of each well is driven into the oil stratum in a configuration in which each probe is directed toward the other. The distance of the respective probes from each other will, depending upon factors of voltage, current flow and geological conditions, be disposed as close as 25 feet apart or, in any given instance, as far as 3,000 feet apart.

42232 Well drilling method and apparatus therefor. Shirley, K.R. (to A-Z International Tool Co.). US Patent 4,083,405. 11 Apr 1978. Filed date 27 Jan 1977. 8p.

The method and apparatus for drilling a well bore and setting a liner therein is disclosed in which the drill string with a bit and underreamers thereon also includes a liner supported thereon which has a gripping assembly with two sets of gripping elements and a pair of external tapers on the liner each of which coacts with one of the sets of gripping elements. One of the gripping elements wedges one set of gripping elements into set position responsive to the liner weight. The other which is spaced from the first one a sufficient distance that it is removed from wedging engagement when the other wedges the other set of gripping elements into set position responsive to upward forces on the liner. A normally closed by-pass around the sealing means on the liner is provided which may be opened responsive to manipulation of the liner to allow cementing of the liner in position within the well bore. The steps are included of lowering the liner on the drill string as the well bore is being formed, setting the liner, gripping assembly and sealing means, opening the by-pass around the liner sealing means and cementing the lever in the well bore.

42233 Fluid contact monitoring in some western Canadian reefs. Pickel, J.S.; Heslop, A. *Log Anal.;* 19: No. 2, 5-12(1978).

From CWLS sixth formation evaluation symposium; Calgary, Canada (24 Oct 1977).

Thirty years have passed since oil was first discovered in reefal reservoirs in the Western Canadian Sedimentary Basin. The early giants such as Redwater, Leduc, and the large Swan Hill pools have been followed in subsequent years by the development of reef pools of declining size, culminating with the discovery of the Keg River reefs of the Rainbow Zama area some 10 years ago. Unfortunately the majority of reef pools are reaching a mature stage in their productive cycle. With this maturity comes an increasing need for the log analyst to diversify his role from merely recognizing hydrocarbons during the discovery process, to the analysis of remaining hydrocarbon distribution within the depleting reservoir. The monitoring of fluid movement has become an integral part of reservoir description. Geologist, log analyst, reservoir and production engineer must work as a coordinated team to explain the often anomalous fluid distributions that occur in the well bore. Oil recovery from the Devonian Leduc age reef at Golden Spike, Alberta has been, until recently, by displacement with a miscible solvent bank. The monitoring of gas--fluid interfaces has been accomplished by the use of pulsed neutron logs in cased holes and the combination of SNP-Density and SNP-Acoustic data in open hole situations. At Judy Creek premature advances of formation water and inefficient reservoir depletion resulted from a highly stratified reefal reservoir. Pulsed neutron logs, used after the recognition of the production problems, have helped define oil-water distributions in the reservoir and led to an improvement in recovery efficiency. Rainbow Devonian Keg River reefs are subjected to gas, miscible and water injection recovery schemes. A pool that has been converted from a primary gas expansion drive to water drive by injection has used the pulsed neutron log to monitor the effectiveness of this change.

42234 Reservoir limit testing using production data. Cox, D.O. (Energy Consulting Associates, Inc., Denver). *Log Anal.;* 19: No. 2, 13-17(1978).

A method has been developed to utilize production data for reservoir limit testing when producing pressure is constant. From the derivation of the method, it is seen that an exponential decline in producing rate is the analog to pseudo-steady state flow when production is at constant pressure rather than constant rate. The manner by which formation properties are determined from the extrapolated initial rate and the rate of decline in production is presented. Example computations are given for field examples; good agreement exists between reported formation properties and those obtained using the methods of this paper.

PROCESSING

REFER ALSO TO CITATION(S) 42146, 42172, 42253

42235 Hydrocarbon conversion with an acidic, sulfur-free trimetallic catalytic composite. Wilhelm, F.C. (to Universal Oil Products Co.). US Patent 4,083,806. 11 Apr 1978. Filed date 17 Jun 1976. 26p.

Hydrocarbons are converted by contacting them in a substantially sulfur-free environment at hydrocarbon conversion conditions with an acidic, sulfur-free trimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum group component, a tin or lead component, a nickel component and a halogen component with a porous carrier material. The platinum

group component, tin or lead component, nickel component, and halogen component are present in the trimetallic catalyst in amounts respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt % platinum group metal, about 0.01 to about 5 wt % tin or lead, about 0.01 to about 5 wt % nickel, and about 0.1 to about 3.5 wt % halogen. Moreover, these metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum group metal is present therein in the elemental metallic state, the major portion of the nickel component is present in the elemental metallic state, while substantially all of the tin or lead is present therein in an oxidation state above that of the elemental metal. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low-octane gasoline fraction within the gasoline fraction and a hydrogen stream are contacted in a substantially sulfur-free trimetallic catalyst disclosed herein at reforming conditions.

42236 Aromatic hydrocarbon separation process. Asselin, G.F.; Witt, P.A. (to UOP Inc.). US Patent 4,083,772. 11 Apr 1978. Filed date 19 Jul 1976. 12p.

A solvent extraction process for separating polar hydrocarbons. The solvent-rich extract phase is introduced into a stripping column through two separated loci; the bottoms from the stripping column, a polar hydrocarbon-containing, solvent-rich stream, is introduced into an upper portion of the solvent recovery column. Polar hydrocarbons in concentrated form are recovered as an overhead stream, a lean solvent stream, virtually free from hydrocarbons, is withdrawn as a bottoms product and recycled in part to the extraction zone, and admixed in part with that portion of the extract phase introduced into the upper of the two separated loci. An internally prepared vaporous stripping medium is introduced into the lower portion of the solvent recovery column.

42237 Hydrorefining of petroleum fraction utilizing a catalyst prepared with an anion complex of a group VI-B and a group VIII metal component. O'Hara, M.J. (to UOP Inc.). US Patent 4,083,771. 11 Apr 1978. Filed date 13 May 1977. 8p.

A hydrorefining process is disclosed. A petroleum hydrocarbon fraction is treated at hydrorefining conditions in contact with a catalyst comprising a Group VIII metal and a Group VIB metal component impregnated on a refractory inorganic oxide. A more active catalyst results from the use of an impregnating solution comprising an anionic complex of a Group VIB and a Group VIII metal.

42238 Hydrocracking hydrocarbons over tri-metallic catalyst. Pollitzer, E.L.; Hayes, J.C. (to UOP Inc.). US Patent 4,082,649. 4 Apr 1978. Filed date 27 Jan 1977. 26p.

A process is claimed for hydrotreating (hydroprocessing) hydrocarbons and mixtures of hydrocarbons utilizing a catalytic composite comprising a porous carrier material containing, on an elemental basis, about 0.01 to about 2 wt. % platinum group metal, about 0.5 to about 5 wt. % cobalt, about 0.01 to about 5 wt. % germanium and about 0.1 to about 3.5 wt. % halogen. The platinum group metal, cobalt and germanium are uniformly dispersed throughout the porous carrier material. Substantially all of the platinum group metal is present in the elemental metallic state, but substantially all of the germanium is present in an oxidation state above that of the elemental metal. Substantially all of the cobalt is present in the elemental metallic state or in a state which is reducible to the elemental metallic state under hydrocarbon conversion conditions or in a mixture of these states, in which process there is effected a chemical consumption of hydrogen. A specific example of one such catalyst is a composite of a crystalline aluminosilicate, a platinum group metal component, a cobalt component, a germanium component, and a halogen component, for utilization in a hydrocracking process. Other hydrocarbon hydroprocesses are directed toward the hydrogeneration of aromatic nuclei, the ring-opening of cyclic hydrocarbons, hydrogenation, etc.

42239 Intermittent catalyst addition system. Andon, N.A.; Fleece, R.I. (to Marathon Oil Co.). US Patent 4,082,513. 4 Apr 1978. Filed date 23 Aug 1976. 4p.

Catalyst, e.g., for a fluid catalytic cracker, is added automatically by a system consisting of an addition hopper which is periodically fed by gravity from a storage hopper, sealed off from the supply, and then pressurized with air to discharge its contents to the carrier gas line feeding the hydrocarbon conversion unit, e.g., the regenerator section of a Fluid Catalytic Cracking Unit. Sequencing can be by electronic timer-solenoid (or pneumatic) valve system.

42240 Simultaneous and continuous hydrocracking production of maximum distillate and optimum lube oil base stock. Hutchings, L.R.E.; Sahlin, T.E. (to UOP Inc.). US Patent 4,082,647. 4 Apr 1978. Filed date 9 Dec 1976. 10p.

A process is provided for the simultaneous and continuous hydrocracking of two feed stocks for production of maximum distillate and optimum lube oil base stock. The second feed is mixed with vaporous phase from separation of effluent from conversion of first feed stock, preferably deasphalted crude resid.

42241 Process for separating solid asphaltic fraction from hydrocracked petroleum feedstock. Murphy, J.R. (to Pullman, Inc.). US Patent 4,082,648. 4 Apr 1978. Filed date 3 Feb 1977. 22p.

A pretreating process for upgrading heavy petroleum feedstocks is disclosed. In a pretreating zone, the feedstock is contacted, in the presence of hydrogen, with a cracking catalyst. In this pretreating zone, the heavy metals content of the feedstock is reduced, and a significant quantity of the feedstock coke precursors are converted directly to oils which are readily recoverable from the pretreating zone effluent. Further, some unconverted coke precursors and the heavy metals complexed therewith are separated from the pretreating zone effluent in a solid asphaltic fraction. The pretreating zone effluent in a solid asphaltic fraction. The pretreating zone effluent remaining after separation of this solid asphaltic fraction is an upgraded feedstock having significantly reduced heavy metal, sulfur, and Conradson carbon residue contents.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 43732

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42260

42242 (AD-A—045613) **2-person non-zero-sum game model of the World oil market. Technical report.** Shenoy, P.P. (Cornell Univ., Ithaca, N.Y. (USA). School of Operations Research and Industrial Engineering). Aug 1977. Contract N00014-75-C-0678. 25p. NTIS PCA02;MF A01.

The world oil market is modelled as a 2-person non-zero-sum game in normal form. The two players are the oil importing nations and the oil exporting nations. The solution of the game is investigated in the noncooperative sense using the Nash's equilibrium point concept and in the cooperative sense using von Neumann and Morgenstern's negotiation set and Nash's barganing point solution.

42243 (PB—274000) **U.S. oil and natural gas findings costs. A study for the Federal Energy Administration. Volume I.** (Shriver (R.) Associates, Parsippany, N.J. (USA)). Jul 1977. Contract FEA-CR-05-60731-00. 171p. NTIS PC A08/MF A01.

This study establishes costs for U.S. oil and gas exploration efforts historically, and projects the level of such costs in 1980, 1985, and 1990. Data was developed for 17 onshore and 2 offshore regions in the Continental U.S. where the petroleum industry has traditionally focused its operations. In addition, two onshore and two offshore sectors of Alaska as well as the offshore Atlantic Coast region that are now becoming the focal points of much new exploratory activity were also examined. The Research is presented in terms of total dollar costs per foot drilled for oil and gas wells in six separate categories in each region. Volume 1 presents the results, and details the methodology used to develop the statistics. (Portions of this document are not fully legible)

42244 (PB—274001) **U.S. oil and natural gas finding costs. A study for the Federal Energy Administration. Volume II. Statistical appendix.** (Shriver (R.) Associates, Parsippany, N.J. (USA)). Jul 1977. Contract FEA-CR-05-60731-00. 329p. NTIS PC A15/MF A01.

Contents: Total finding costs per foot statistics. 1961-1974 for historical regions (oil - regions 1-16, 22, 23; gas - regions 1-13, 15-17, 23); Exploratory drilling cost per foot statistics. 1961-1974 (plus 1980, 1985, 1990 for tables 8 and 17) for historical regions (oil - regions 1-16, 22, 23; gas - regions 1-13, 15-17, 23); Geological and geophysical costs; Lease rental and bonus costs; Historical surface cost summary. (Portions of this document are not fully legible)

42245 (PB—274397) **Monthly petroleum product price report, July 1977.** Bordeaux, C.B.; Davis, W.; Whatley, A.; Foster, C.M.; Gillespie, W. (National Energy Information Center, Washington, D.C. (USA)). Jul 1977. 20p. (CRN—771121-00004; EDR-M—746/M(7707)). NTIS PC A02/MF A01.

This report provides national weighted average prices of petroleum products on a monthly basis at different levels of the marketing chain. In addition to recent price data, some historic data are included to indicate trends.

42246 Oil statistics 1976: supply and disposal. Paris; Organisation for Economic Co-operation and Development (1976). 335p. $13.00.

Summary tables are included for the period 1960 to 1976. The detailed tables for 1976 cover production, supply and disposal; supply and disposal by product; imports by sources; imports from member countries; exports by destination; exports to member countries; consumption by end-use sectors; and supply and disposal of finished products by country (1975 and 1976). (DLC)

WASTE MANAGEMENT

42247 (PB—275167) **Inspection manual for the enforcement of new source performance standards: fuel gas fired combustion units. Final report.** Umlauf, G.E.; Parehk, B. (Pacific Environmental Services, Inc., Santa Monica, Calif. (USA)). Aug 1976. Contract EPA-68-01-3156. 47p. NTIS PC A03/MF A01.

This document outlines the air pollution requirements of Federal New Source Performance Standards for petroleum refinery combustion units which are fired on fuel gas. It is designed to be utilized by agency personnel who are responsible for the enforcement of these regulations. Briefly, the rules are applicable to all combustion units on which construction or modification was commenced after June 11, 1973. If fuel gas is burned in the unit, it is required that the fuel gas be desulfurized to a level of 230 mg/dscm (0.1 gr/dscf) or below, or that effluent combustion gases be treated for sulfur dioxide removal to an equivalent level. This manual also outlines other requirements of the regulation for performance testing, monitoring and record keeping and reporting requirements. Subsequent sections of the document describe types of emission control systems which may be used; procedures for conducting on-site inspections including an inspector's checklist; and approved methods for conducting performance tests.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42259, 42261, 43596, 43612, 43720

42248 (NP—23213) **Outer Continental Shelf Environmental Studies Advisory Committee annual report to the Secretary, Department of the Interior, Calendar Year 1976.** (Department of the Interior, Washington, D.C. (USA)). 28 Feb 1977. 153p. Dept. of Interior, Washington, DC.

The Outer Continental Shelf (OCS) Environmental Studies Advisory Committee is one of two OCS advisory bodies which superseded the OCS Research Management Advisory Board. This report relates primarily to technical aspects of the Department's OCS environmental program which is managed by the Bureau of Land Management (BLM). The environmental program on which advice is being given is summarized and pertinent aspects of Committee activities for the year are reviewed. Certain details concerning both the environmental program and Committee work are included.

42249 (PB—272966) **Outer Continental Shelf (OCS) oil and gas lease sale No. CI: lower Cook Inlet. Volume 1, Part 1. Final environmental impact statement.** (Bureau of Land Management, Anchorage, Alaska (USA). Alaska Outer Continental Shelf Office). 3 Dec 1976. 589p. (BLM/ME—78-04a). NTIS PC A25/MF A01.

A sum of 152 tracts (0.36 million hectares) are proposed to be leased for exploration, development and production of oil and gas. They are located offshore of the Kenai Peninsula. Volume 1 includes the Proposal, Description of the Environment, and Impact of the Proposal.

42250 (PB—272967) **Outer Continental Shelf (OCS) oil and gas lease sale No. CI: lower Cook Inlet. Volume 1, Part 2. Final environmental impact statement.** (Bureau of Land Management, Anchorage, Alaska (USA). Alaska Outer Continental Shelf Office). 3 Dec 1976. 574p. (BLM/ME—78-04b). NTIS PC A24/MF A01.

A sum of 152 tracts (0.36 million hectares) are proposed to be leased for exploration, development and production of oil and gas. They are located offshore of the Kenai Peninsula. Volume 1 includes the Proposal, Description of the Environment, and Impact of the Proposal. (Portions of this document are not fully legible)

42251 (PB—272969) **Outer Continental Shelf (OCS) proposed oil and gas leasing in the northern Gulf of Alaska. sale No. 39. Volume 1. Final environmental impact statement.** (Bureau of Land Management, Anchorage, Alaska (USA). Alaska Outer Continental Shelf Office). 19 Nov 1975. 472p. (BLM-ME—78-06). NTIS PC A20/MF A01.

A sum of 330 tracts (about 728,450 hectares) are proposed to be leased for exploration, development and production of oil and gas. They are offshore of the northern Gulf of Alaska. Volume 1 includes the Proposal and Description of the Environment.

42252 (PB—275162) **Screening study to determine need for SOx and hydrocarbon NSPS for FCC regenerators.** (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Aug 1976. Contract EPA-68-02-1332. 187p. NTIS PC A09/MF A01.

The report quantifies the emissions from a typical Fluid Catalytic Cracking (FCC) unit and identifies and presents all available data that would define the emission levels that can be achieved with the most effective demonstrated control systems for FCC units. In addition, estimated emission reductions that would result through promulgation of new source performance standards for FCC units have been prepared.

42253 (PB—275685) **Revision of emission factors for petroleum refining. Final report.** Burklin, C.E. (Radian Corp., Austin, Tex. (USA)). Oct 1977. Contract EPA-68-02-1889. 85p. NTIS PC A05/MF A01.

The refinery air pollutant emission factors presently contained in Section 9.1 of AP-42, A Compilation of Air Pollutant Emission Factors are primarily based on the results of the Los Angeles Joint Project conducted from 1955 to 1958. Since that time there have been many process and equipment developments in the petroleum refining industry. There have also been several individual and control agency emission testing programs for refinery emission sources. This report presents the results of an in-depth study to revise and update the emission factors and process descriptions presented in AP-42 for the petroleum refining industry. The revisions were to be made only using available information. A testing strategy was also developed for testing refinery emission sources where further source testing is warranted.

42254 **Introduction to the symposium on recovery potential of oiled marine northern environments.** Vandermeulen, J.H. (Bedford Inst. of Oceanography, Dartmouth, Nova Scotia). *J. Fish. Res. Board Can.;* **35**: No. 5, 505-508(May 1978).

The problem of environmental recovery following an oil spill was covered in three consecutive sessions, each of about a dozen papers. the first papers dealt with the chemical and physical changes in the oil following a spill. The presentations then moved to the various absorption and degradative mechanisms operating in the environment, be they physical, microbial, or physiological. The final series of papers focused on the long-term recovery patterns. The eventual recovery of oiled marine populations and ecosystems was demonstrated to be somewhere between 5 and 15 years depending on the spill conditions. Large molecular weight components of the oil persist much longer than the observed ecological recovery times. The persistence of hydrocarbon in tissues, hydrocarbon utilizing bacteria, the problem of maintaining control sites free of hydrocarbons, and the matter of research funding were also discussed.

42255 **Analyses of aromatic hydrocarbons in intertidal sediments resulting from two spills of No. 2 fuel oil in Buzzards Bay, Massachusetts.** Teal, J.M. (Woods Hole Oceanographic Inst., MA); Burns, K.; Farrington, J. *J. Fish. Res. Board Can.;* **35**: No. 5, 510-520(May 1978).

We have analyzed the two- and three-ring aromatic hydrocarbons from the Wild Harbor oil spill in September 1969 and the Winsor Cove oil spill in October 1974, in intertidal marsh sediments, using glass capillary gas-chromatographic and mass-fragmentographic analyses. Naphthalenes with 0 to 3 alkyl substitutions and phenanthrenes with 0 to 2 substitutions decreased in concentration with time in surface sediments. The more substituted aromatics decreased relatively less and in some cases actually increased in absolute concentration. The changes in composition of the aromatic fraction have potential consequences for the ecosystem and provide insight into geochemical processes of oil weathering.

42256 **Long-term fate of a heavy fuel oil in a spill-contaminated B.C. coastal bay.** Cretney, W.J. (Inst. of Ocean Sciences, Sidney, British Columbia); Green, D.R.; Bawden, C.A. *J. Fish. Res. Board Can.;* **35**: No. 5, 521-527(May 1978).

The fate of accidently spilled No. 5 fuel oil in a small coastal bay in British Columbia was observed 6 times during 4 yr. The oil's composition was first changed by loss of the lower molecular weight components by evaporation and dissolution. Biodegradation accounted for almost complete removal of n-alkanes in the 1st yr. Pristane and phytane were biodegraded more slowly, but were almost completely gone in 4 yr. The non-n-alkane components in the nC/sub 28-30/ range seem to be the most resistant to degradation of all the components resolved in the gas chromatograms. The resistance to degradation of these components indicates their potential for long-term studies of oil spills.

42257 **Aromatic hydrocarbons in benthic organisms from coastal areas polluted by Iranian crude oil.** Grahl-Nielsen, O.; Staveland, J.T.; Wilhelmsen, S. (Inst. of Marine Research, Bergen-Nordnes, Norway). *J. Fish. Res. Board Can.;* **35**: No. 5, 615-623(May 1978).

This investigation was begun 1 mo after a spill of 2000 tons of Iranian crude oil polluted shores along the west coast of Norway in

February 1976. It is based on mass-fragmentographic analysis of naphthalene, methyl-, dimethyl-, and trimethylnaphthalenes, phenanthrene, methyl- and dimethylphenanthrenes, dibenzothiophene, methyl-, dimethyl-, and trimethyldibenzothiophenes. Samples of stranded oil, water, and seven species of benthic organisms were collected periodically during the following year. During the 1st mo of weathering the total amount of these aromatic compounds had decreased from 1.22% in the original oil to 0.76%, with a further decrease to 0.2 to 0.3% during the next 3 to 4 mo. In the water the concentration of these compounds was approximately 2 μg/L (ppB) at the start of the sampling. At one of the investigated locations a chemical dispersant was used in cleaning the shores. This resulted in higher concentrations of the aromatic compounds in the water, up to 12 μg/L. The organisms studied had accumulated aromatic hydrocarbons up to an excess of 20 μg/g wet weight, 1 mo after the spill. Although seasonal and individual differences were large, the dibenzothiophenes appeared to be retained to a larger extent relative to the naphthalenes and phenanthrenes.

42258 Preliminary ecological-genetic comparison between unperturbed and oil-impacted Urosalpinx cinerea (Prosobranchia: Gastropoda) populations: Nobska Point (Woods Hole) and Wild Harbor (West Falmouth), Massachusetts. Cole, T.J. (Boston Univ. Marine Program, Woods Hole, MA). *J. Fish. Res. Board Can.;* 35: No. 5, 624-629(May 1978).

Catastrophes, whether natural or man-made, impinge on populations of organisms by increasing mortality, thus reducing population numbers. Recent theoretical studies indicate that demographic and genetic changes may result from such events. The 1969 oil spill at Wild Harbor offered an opportunity to obtain empirical data on this relationship between ecology and genetics. The organism studied was the oyster drill Urosalpinx cinerea (Say, 1822). Monthly samples (April to September) were collected for each 3 yr (1973 to 1975) from the recolonizing population at Wild Harbor and from a long-standing population at Nobska Point. Genotypes at two allozymic loci (ODH and LAP) were determined. Demographic information was obtained by mark-recapture experiments during 1973 to 1975. Analyses of population dynamics indicated that a reasonably functioning population has been reestablished at Wild Harbor. However, genetic structure (as revealed by genotypic distributions) of Wild Harbor drills exhibited generally greater year-to-year variation than did Nobska organisms. This may have resulted from genetic change caused by gene migration from different coadapted gene complexes and from stochastic "founder" effects. More information on the interdigitation of ecology and genetics is needed, however, before implications of these findings are fully realized.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 43125, 43590

42259 (PB—273964) **Oil pollution control (an oversimplified explanation).** Smith, A. (Environmental Protection Agency, Atlanta, Ga. (USA). Region IV). Jan 1972. 12p. NTIS PC A02/MF A01.

The non-technical handler of petroleum products in informed, in low keyed language, on the principal features of the oil spill regulations in the 1970 Federal Water Pollution Control Act. Some simple containment and cleanup techniques are diagramed.

42260 (PB—274948) **Federal policies affecting the wellhead value of Prudhoe Bay crude oil. A report to the Alaska legislative council's subcommittee on oil and gas leasing and taxing policies, ninth Alaska state legislature.** Tussing, A. (Alaska Univ., College (USA). Inst. of Social, Economic and Government Research). 28 Mar 1977. 124p. NTIS PC A06/MF A01.

Markets for North Slope crude; FEA price ceilings and Prudhoe Bay crude oil prices; entitlements treatment of North Slope crude; and the question of exports and the long term oil supply picture are covered.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 42200, 42249, 42968

STORAGE

42261 (PB—273544) **Strategic petroleum reserve: Capline Group Salt Domes. Bayou Choctaw Expansion, Chacahoula, Iberia, Napoleonville, Weeks Island Expansion. Volume III. Draft environmental impact statement.** (Federal Energy Administration, Washington, D.C. (USA)). Sep 1977. 549p. (FEA/S—77/341; DES—77/9(Vol.3)). NTIS PC A23/MF A01.

This document is a site specific Environmental Impact Statement (EIS) for five candidate sites comprising the Capline Group of salt domes located in the Gulf Coast region of south central Louisiana. The primary site for Strategic Petroleum Reserve (SPR) development in this group is the Napoleonville salt dome located in Assumption Parish, Louisiana. Of the other four sites, two are expansions of Early Storage Reserve facilities, and two are new sites. This site specific EIS analyzes the environmental impacts which could occur during site preparation and operation at each of the five locations. Volume 3 contains appendices C through J. (Portions of this document are not fully legible)

42262 (PB—275415) **Analysis of brine disposal in the Gulf of Mexico. (1) Bryan Mound.** Bishop, J.M. (National Oceanic and Atmospheric Administration, Washington, D.C. (USA). Center for Experiment Design and Data Analysis). Feb 1977. 182p. NTIS PC A09/MF A01.

In implementing the Strategic Petroleum Reserve (SPR), the Federal Energy Administration (FEA) proposes to use storage caverns leached-out of the Bryan Mound salt dome on the coast of Texas near Freeport. Discharge into the Gulf of Mexico is an alternative under consideration for disposal of the saturated brine now in existing caverns and brine to be produced as additional caverns are solution-mined. This report was prepared to assist FEA in a full examination of potential environmental impacts of this brine disposal alternative as that agency presses to meet the legislative mandate of the SPR Program. (Portions of this document are not fully legible)

42263 (PB—275416) **Analysis of brine disposal in the Gulf of Mexico. (2) West Hackberry.** Bishop, J.M. (National Oceanic and Atmospheric Administration, Washington, D.C. (USA). Center for Experiment Design and Data Analysis). Mar 1977. 123p. NTIS PC A06/MF A01.

In implementing the Strategic Petroleum Reserve (SPR), the Federal Energy Administration (FEA) proposes to use storage caverns leached-out of the West Hackberry salt dome on the coast of Louisiana near Lake Calcasieu. Discharge into the Gulf of Mexico is an alternative under consideration for disposal of the saturated brine now in existing caverns and brine to be produced as additional caverns are solution-mined. This report was prepared to assist FEA in a full examination of potential environmental impacts of this brine disposal alternative as that agency presses to meet the legislative mandate of the SPR Program. An extensive summary of meteorological, oceanographic, and bathymetric conditions in the West Hackberry study area is provided based upon existing data and information. An overview of ecological conditions in the study area has also been prepared.

42264 (PB—275417) **Analysis of brine disposal in the Gulf of Mexico. (4) Big Hill.** Thompson, G.D. (National Oceanic and Atmospheric Administration, Washington, D.C. (USA). Center for Experiment Design and Data Analysis). Jul 1977. 159p. NTIS PC A08/MF A01.

To implement the Strategic Petroleum Reserve (SPR) Program, the Federal Energy Administration (FEA) proposes to use storage caverns leached out of a salt dome known as Big Hill on the coast of Texas 15 miles west of Sabine Pass. Discharge into the Gulf of Mexico is being considered for disposal of the saturated brine to be produced as a result of creating these solution-mined caverns. This report will assist FEA in fully examining the potential environmental impact of this brine disposal option. It includes: an extensive summary of physiographic, meteorological, oceanographic, and water quality conditions along the Texas coast adjacent to the Big Hill site; a comprehensive review of ecological conditions in the area; analysis of the dispersion of salt brine to be discharged at the two locations offshore, under various environmental conditions; general considerations for a brine diffuser at the Big Hill site; and the potential impact of brine due to osmotic stress.

COMBUSTION

REFER ALSO TO CITATION(S) 42211, 42212, 42648

NATURAL GAS

REFER ALSO TO CITATION(S) 43147

RESERVES

REFER ALSO TO CITATION(S) 43131

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 42224, 42226, 42229, 42249, 42250, 42251, 42576, 43751

42265 (NVO—0655-106) **Western Gas Sands Project status report.** (CER Corp., Las Vegas, Nev. (USA)). 1 Apr 1978. Contract EY-76-C-08-0655. 75p. Dep. NTIS, PC A04/MF A01.

Progress of the major government sponsored projects undertaken to increase gas production from the low permeability gas sands of the western United States during February, 1978 is summarized. The Western Gas Sands Project files, which contain raw data and published reports from each Western Gas Sands Project participant have been established. A log file containing logs from pertinent wells in the four study areas has also been established. The U.S. Geological Survey (USGS) is continuing geological and geophysical studies in the four study areas for resource assessment. A number of papers giving results of recent investigations were presented at meetings during the month. The Bartlesville Energy Research Center (BERC) and participating National Laboratories are continuing their work in research and development. Field tests and demonstrations continue in the Uinta and Piceance Basins at the following locations: Uinta Basin, Gas Producing Enterprises, Inc. (GPE) Natural Buttes Unit Wells No. 14, 18, 19, 20, 21, and 22; Piceance Basin, Mobil Research and Development Corporation Well No. F-31-13G, Rio Blanco Natural Gas Company Well No. 498-4-1.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 42224, 42232

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 42219

42266 **Process for recovery of liquid hydrocarbons.** Millar, J.F.; Cockshott, J.E. (to Fluor Engineers and Constructors, Inc.). US Patent 4,083,194. 11 Apr 1978. Filed date 2 Dec 1976. 6p.

Methane is recovered as a gas for discharge to a pipeline from a gas stream containing methane and heavier hydrocarbons, principally ethane and propane. Separation is accomplished by condensing the heavier hydrocarbons and distilling the methane therefrom. A liquid product (LPG) comprising the heavier hydrocarbons is subsequently recovered and transferred to storage. Prior to being discharged to a pipeline, the recovered methane gas is compressed and in undergoing compression the gas is heated. The heat content of the gas is employed to reboil the refrigerant in an absorption refrigeration unit. The refrigeration unit is used to cool the LPG prior to its storage.

HEALTH AND SAFETY

42267 (AD-A—047585) **Explosion hazards associated with spills of large quantities of hazardous materials. Phase II. Final report.** Lind, C.D.; Whitson, J.C. (Naval Weapons Center, China Lake, Calif. (USA)). Nov 1977. Contract DOT-CG-34095-A. 40p. NTIS PC A03/MF A01.

This report documents the results of Phase II of a program aimed at quantifying the explosion hazards associated with spills of large quantities of hazardous material such as liquefied natural gas and liquefied petroleum gas. The principal results of this phase of the work are: a quantitative empirical description of the burning behavior in fuel-air mixtures, an examination of flame acceleration processes, the observation that, in 17 large scale burn tests, no transition to detonation occurred, and that methane-air mixtures cannot be detonated with moderate size solid explosive boosters. (Author)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42243, 42244, 43130

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 42219, 42248, 42249, 42250, 42251, 43612

42268 (UCID—17593) **Environmental impact assessment of a Devonian shale stimulation experiment, Lawrence and Scioto Counties, Ohio.** Hall, C.H.; Ricker, Y.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1977. Contract W-7405-ENG-58. 48p. Dep. NTIS, PC A03/MF A01.

The impact of an experimental gas stimulation project on the environment in Southern Ohio was assessed. All aspects of the environment required by NEPA and ERDA guidelines are covered. The project is part of a 5-y ERDA research effort to increase commercially recoverable natural gas in the Eastern shale basin. The project objective is to determine the efficacy of certain remote sensing techniques and to compare the results of two relatively new natural gas stimulation techniques: fracturing by cryogenic (methanol and carbon dioxide) and foam (nitrogen and water) methods. The project consists of nine 600-m wells located in the Appalachian foothills. The area is composed of mixed deciduous forest with thick underbrush interspersed with small grazing and crop farms; small hamlets and rural residences dot the area. Extensive resource extraction in this region over the past 150 years has resulted in locally dramatic physical impacts, as evidenced by abandoned "orphan" strip-mining operations. The overall negative impact of the project on the environment appears minimal. Key issues involve possible interference with nesting and forage habitat of two endangered species, presence of archaeological resources on site, and worker safety during cryogenic fracture treatment. Methanol concentrations during discharge of the fracture fluid, using a Gaussian diffusion code and assuming point and line source and three stability conditions, were calculated to vary between 210 and 14,000 ppM at 100 m under worst-case conditions. A number of precautions will be employed to mitigate this condition. Other potential impacts can also be mitigated.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 42265, 42268

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 43125, 43130, 43590

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 42200

PROPERTIES

42269 (PB—272844) **Subsidence over mines and caverns, moisture and frost actions, and classification.** (Bureau of Mines, Amarillo, Tex. (USA)). 1976. 90p. (BM-IC—8749).

The 12 papers in this report deal with the following areas: mechanisms of subsidence due to underground openings; induced and natural sinkholes in Alabama--A continuing problem along highway corridors; subsidence control for structures above abandoned coal mines; ground subsidence associated with dewatering of a depressed highway section; geologic indicators of catastrophic collapse in karst terrain in Missouri; subsurface cavity detection: field evaluation of radar, gravity, and earth resistivity methods; mathematical model for predicting moisture movement in pavement systems; unsaturated transient and steady-state flow of moisture in subgrade soil; evaluation of freeze-thaw durability of stabilized materials; designations of excavation characteristics for materials identified in field investigations; pore structure of selected Hawaiian soils and insulated road study.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 42102

42270 (PNL—2500(Pt.4), pp 4.0-4.10) **Oil shale.** Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

New or improved methods are being developed for organic and inorganic analyses of oil shale and tar sand effluents. Research materials are being prepared for characterization, environmental, and health effects studies. (DLC)

42271 **Symposium on oil sand and oil shale.** Washington, DC; American Chemical Society (1977). 233p. (CONF-770510—P1). University Microfilms, Ann Arbor, MI $8.00.

From American Chemical Society meeting; Montreal, Canada (May 1977).

Papers presented at the conference are concerned with Canada oil sands, chemistry of tar sands, shale oil production, properties of oil shales, properties of asphaltenes, kerogen, and hydrocarbon biodegradation. A separate abstract was prepared for each paper. (JRD)

SITE GEOLOGY

REFER ALSO TO CITATION(S) 42227

DRILLING, FRACTURING, AND MINING

42272 **Thermomechanical fracture for recovery system in oil shale deposits.** Bohn, J.R.; Pearson, D.J. (to TRW Inc.). US Patent 4,083,604. 11 Apr 1978. Filed date 15 Nov 1976. 8p.

In a process for the recovery of resources from underground geological structures, the process is improved by fracturing the walls of the underground structure and large boulders or rocks by inducing thermal gradients in the deposits. Determination of the thermal gradients which will produce the desired fracturing pattern in each specific deposit involves subjecting a core sample to a controlled heating program. When the heating program has been established from tests on the core sample, it is then applied to the underground formation.

42273 **Mining oil shale and backfilling with mechanically compressed spent shale.** Gwyn, J.E. (to Shell Oil Co.). US Patent 4,081,968. 4 Apr 1978. Filed date 16 Feb 1977. 4p.

The producing of shale oil by mining and retorting oil shale is improved by compressing the spent shale into a mass that is capable of both fitting within the mined out volume and supporting the overburden.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 43132

42274 (PB—27456) **Status report on the gas potential from Devonian Shales of the Appalachian Basin.** (Office of Technology Assessment (U.S. Congress), Washington, D.C.). Nov 1977. 83p. (OTA-E—57). NTIS PC A05/MF A01.

This report examines the potential for producing gas from the Devonian shales of the Appalachian Basin -- using existing technology under a variety of economic assumptions. The report describes the Devonian shale resource as well as general reservoir characteristics. The economics of Brown shale gas production are discussed as are the barriers to production that currently exist. Policy options to encourage the production of shale gas are presented.

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 42848

42275 (LERC/RI—78/2) **Colorado's primary oil-shale resource for vertical modified in-situ processes.** Smith, J.W.; Beard, T.N.; Trudell, L.G. (Department of Energy, Laramie, Wyo. (USA). Laramie Energy Research Center). Apr 1978. 74p. Dep. NTIS, PC A04/MF A01.

Portions of document are illegible.

Vertical modified in-situ processes for oil-shale development require an accessible, thick and continuous oil-shale section. In Colorado's Piceance Creek Basin the Mahogany zone and its overlying oil-shale is the Green River Formation section that best meets these requirements. This oil-shale section is described and evaluated in detail with contour maps of richness, thickness, and oil resource in place. Seven cross sections were constructed to provide the framework necessary for basin-wide correlation of assay results from 189 cores. These correlations form the basis for detailed contouring and resource evaluation of the Mahogany zone, A-groove, and 5 overlying oil-shale sections. Total oil in place basin-wide in this primary resource is 419 billion barrels (61 billion tonne) with 85% occurring in areas with resource exceeding 400,000 bbls per acre (143,000 tonne/hectare). 95% of the resource occurs where average richness of the total section exceeds 14 gallons per ton (58 liter/tonne). Thickness of the continuous section reaches 600 feet (183 meters) and virtually all the resource occurs in sections thicker than 300 feet (91 meters). 24 figs.

42276 (SAND—78-0319) **Development of a solid-electrolyte oxygen sensor for in situ oil shale retorting applications: final report.** Haaland, D.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 61p. Dep. NTIS, PC A04/MF A01.

A new solid-electrolyte oxygen sensor has been developed suitable for air-fired in situ oil shale retorting applications. By eliminating the flowing gas reference of conventional solid-electrolyte sensors, only electrical leads to the surface are required for oxygen monitoring. The new design consists of two electrochemical cells of stabilized-zirconia solid electrolyte sealed into a small unit. One electrochemical cell monitors the ratio of oxygen partial pressures inside and outside the sensor while the second cell is used as a quantitative electrochemical oxygen pump. The initial measurement procedure requires that all oxygen be electrochemically removed from the known internal volume of the sensor by applying a potential across the second cell. The polarity of the potential is then reversed so that oxygen from the surrounding gas is electrochemically pumped back into the sensor. When the emf of the first cell reaches zero, the oxygen partial pressure inside the sensor is equal to that of the surrounding gas. Integrating the current required to achieve this condition yields the number of moles of oxygen pumped into the sensor. This information is used in the ideal gas law to calculate oxygen partial pressures. Tests of these sensors were conducted from 400 to 1000°C in clean mixtures of oxygen and nitrogen spanning about 0.1 to 21% oxygen concentration range with reasonable accuracy. Tests in non-equilibrium gas mixtures of combustible gases in the presence of oxygen indicated significant catalytic reaction at the surface of the platinum electrodes. Thus accurate bulk gas phase oxygen measurements could not be made with sensors using pure platinum electrodes. Extensive studies of a variety of less catalytic electrode materials were made. The best results were obtained using a 50/50 mixture of PbS/Pt over sputtered platinum. These electrodes were non-catalytic above approximately 550°C.

42277 **Electrode well for electrically heating a subterranean formation.** Todd, J.C. (to Petro Canada Exploration Inc.). US Patent 4,084,639. 18 Apr 1978. Filed date 16 Dec 1976. 8p.

An improved electrode for electrically heating a subterranean formation includes a plurality of electrically conductive rod-like members that extend outwardly from a central well bore to provide increased area for conducting electrical current from a source into said subterranean formation. The improved electrode apparatus is adapted to be lowered into a well bore which has been drilled into the subterranean formation and, thereafter, the plurality of rod-like members are driven outwardly from the central well bore. Guide means are provided to direct the rod-like members outwardly into the subterranean formation as a central member is forced downwardly.

42278 **Method of producing viscous materials from subterranean formations.** Todd, J.C. (to Petro Canada Exploration Inc.). US Patent 4,084,637. 18 Apr 1978. Filed date 16 Dec 1976. 14p.

A method of producing viscous materials from subterranean formation comprises a plurality of steps. At least two wells are drilled and completed into the subterranean formation that contains the viscous material. At least one of the wells is completed as an injection well and one of the wells is completed as a production well. A plurality of electrode wells are drilled into the subterranean formation with the plurality of electrode wells being generally arranged in a pattern to define at least one path between the production well and the injection well with the length of the path being substantially greater than the distance between the production well and the injection well. The electrode wells are spaced apart along the path at distances that are substantially less than the distance between the production well and the injection well. Thereafter, a voltage is applied across the adjacent pairs of electrode wells to thereby cause an electrical current to pass through the subterranean formation between each adjacent pair of the electrode wells. As the electrical current passes through the subterranean formation, the viscous material is heated to thereby lower the viscosity of such material. Following the heating of the subterranean formation in the vicinity of the path formed by the electrode wells, a driving fluid is injected through the injection wells to thereby migrate along the path and force the material having a reduced viscosity toward the production well. The material is produced through the production well and by continuing to inject a heated fluid through the injection wells, substantially all of the viscous material in the subterranean formation can be heated to lower its viscosity and be produced from the production well.

42279 **Combined combustion for in-situ retorting of oil shales.** Allred, V.D. (to Marathon Oil Co.). US Patent 4,084,640. 18 Apr 1978. Filed date 4 Nov 1976. 6p.

Shale oil is recovered from oil shale formations by rubblizing or otherwise fracturing the formation establishing zones for an oxidizing gas injection and off gas and product recovery, igniting the formation at a point intermediate between the injection and recovery

zones which is the first phase of the process causing a heat front to move cocurrent and a combustion front countercurrent to the injected gas stream followed by a second process phase which occurs when the combustion front reaches the zone of oxidant injection and reverses itself oxidizing the residual organic matter laid down on the retorted shale and supplying additional heat to continue the heat front movement to the product recovery zone and completing the retorting of the shale downstream from the ignition zone while recovering heat from the retorted shale in the form of gas preheat.

42280 Determining the locus of a processing zone in an in situ oil shale retort by sound monitoring. Elkington, W.B. (to Occidental Oil Shale, Inc.). US Patent 4,082,145. 4 Apr 1978. Filed date 18 May 1977. 12p.

The locus of a processing zone advancing through a fragmented permeable mass of particles in an in situ oil shale retort in a subterranean formation containing oil shale is determined by monitoring for sound produced in the retort, preferably by monitoring for sound in at least two locations in a plane substantially normal to the direction of advancement of the processing zone. Monitoring can be effected by placing a sound transducer in a well extending through the formation adjacent the retort and/or in the fragmented mass such as in a well extending into the fragmented mass.

42281 Low temperature oxidation of hydrogen sulfide in the presence of oil shale. Compton, L.E.; Rowan, W.H. (to Occidental Oil Shale, Inc.). US Patent 4,082,146. 4 Apr 1978. Filed date 24 Mar 1977. 20p.

The hydrogen sulfide concentration of a gas of relatively higher hydrogen sulfide concentration is reduced by combining at a temperature less than about 650°F hydrogen sulfide in the gas with oxygen in the presence of a fragmented permeable mass of particles containing oil shale to yield a gas with relatively lower hydrogen sulfide concentration for withdrawing from the fragmented permeable mass.

42282 Recovery of hydrocarbon values by controlled eduction and oxidation of oil shale. Knight, J.H.; St. Cyr, L.A.; Wilson, O.L. (to Superior Oil Co.). US Patent 4,082,645. 4 Apr 1978. Filed date 14 Dec 1976. 12p.

In the process for recovering energy values from oil shale by the cross-flow retort technique, an improvement is disclosed wherein controlled oxidation of nonvaporizable carbonaceous residue not only provides additional heat for the continuation of the oil educing process without application of external heat but also enables the continuation of a temperature profile which is below that at which adverse chemical and physical changes occur in the shale. According to the invention the moving bed is removed from exposure to external heat as soon as oil eduction has been completed in the upper bed regions. It is hereafter immediately exposed to unheated gases containing measured amounts of oxygen. Oxidation is initiated in those regions of the bed which are above about 800°F. The heat generated by such oxidation may be utilized, in place of externally heated gases, to transfer heat to the lower regions of the bed for oil eduction from those lower regions.

SURFACE METHODS

42283 (BNWL—2100(Pt.4), pp 66-82) **Oil shale and tar sand research.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

During the development of new energy technologies, concern has arisen as to their potential effects on human health and the environment. In order to identify these potential effects early in process development, it is necessary to chemically and physically characterize the effluents from various pilot operations. Because of the complex nature of the samples, new sampling and analytical techniques need to be developed. In this section new or improved techniques for both organic and inorganic analysis are described along with applications to effluents from coal conversion, oil shale retorting and geothermal pilot operations. Also described is a program for providing relatively homogeneous and well characterized research materials from oil shale and coal conversion pilot plants for biological and environmental studies and interlaboratory comparison.

42284 (UCID—17770) **Effects of steam on oil shale retorting: a preliminary laboratory study.** Campbell, J.H.; Taylor, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1978. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

This preliminary study reports the effects of flowing steam (1-atm total pressure) on the pyrolysis of shale and subsequent decomposition of mineral carbonates. Results show that steam enhances oil yield during pyrolysis. However, this effect depends strongly on the size of the shale particles and produces significant yield enhancement only for small particles (powdered shale <800 μm). No dramatic change in the properties of the product oil resulted from retorting in steam. We also measured the rate of mineral carbonate decomposition and found it to be accelerated in the presence of steam. For example, the dolomite decomposition rate increased threefold in the presence of 100% steam (1 atm).

42285 Total yields from heated oil sands. Stangeby, P.C.; Sears, P.L. (Univ. of Toronto). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 3, 217-221(1977).

From Symposium on oil sand and oil shale; Montreal, Canada (29 May 1977).

The yield of volatile materials from tar sand samples during heating was investigated. The experimental work provided little opportunity to investigate the products of reaction. However, evacuation of the reaction vessel to 100 microns before heating the sample allowed measurement of the gas pressure resulting from reaction. Pressure increases of the order of 100 microns were recorded, but these were consistently higher for slower than for faster heating rates. This implies that the material volatilized has a greater liquid/gas ratio when rapid heating is used. About 12.9% of the weight of the supplied oil sand is volatilized by heating to 500°C. Rapid heating, higher temperatures, and prolonged heating have little effect on this figure. If the original analysis figures are to be trusted, this implies about 80% yield of bitumen as oil and gas. The oil/gas ratio is probably greater for higher heating rates. High pressures of inert gas reduce the yield, while high pressure hydrogen increases it. Work in hand on this system includes carbon analyses on the pyrolyzed residues to provide a check on the fate of the bitumen which is not volatilized. A gas chromatographic study of the volatilized material is in the preparatory stages.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 43650, 43739

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42183, 42283

42286 (TID—27903) **Environmental monitoring plan.** Haack, B.; Istvan, L.; Sampson, R.; Tanis, F.; Thomson, F. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). May 1977. Contract EX-76-C-01-2346. 32p. Dep. NTIS, PC A03/MF A01.

The major activity under this contract is the periodical monitoring of a variety of water, land, and air environmental parameters, to determine changes in the environment caused by various drilling, fracturing, and combustion activities at the Peck, Michigan, site. Because of uncertainties in the nature and level of future effects, the first year's program has been made deliberately broad, to include many potential effects. The parameters being investigated during the first year are tabulated. It is anticipated that some of the parameters monitored will show no change as a result of the site activities, or changes which are no more than the normal variation in parameters to be expected from year to year. Thus, in succeeding years, a more focused list of parameters should be measured. On the basis of the first year's measurements and analysis, the Environmental Analysis prepared by Mitre Corporation, and The Dow Chemical Company advice, a recommended monitoring program will be developed for future years. An estimate of the environmental effects associated with production operations of Antrim Oil Shale in-situ combustion and energy extraction will be made.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 42100, 43099

RESERVES

42287 (GJBX—12(78)) **1977 NURE uranium geology symposium.** (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Feb 1978. Contract EY-76-C-13-1664. 248p. (CONF-771244—). Dep. NTIS, PC A19/MF A01.

From Symposium on NURE uranium geology; Grand Junction, CO, USA (7 Dec 1977).

This U. S. Department of Energy (DOE) open-file report is a compilation of the materials given to attendees at the 1977 National Uranium Resource Evaluation (NURE) Geology Symposium. The objective of the symposium was to present results of both completed and in progress topical geology projects conducted as a part of the

DOE National Uranium Resource Evaluation program. Topical geology projects are primarily concerned with the study of significant foreign uranium deposits, to identify the criteria that best explain their existence. These criteria or "models" are then used to evaluate analogous U.S. geologic conditions for uranium favorability. Several associated U.S. Geological Survey projects were also presented. Complete written text of the presentations was not provided at the meeting and is not included in this report. All information presented on NURE studies will appear in the DOE open-file reports for each of the projects upon their completion. U. S. Geological Survey speakers may be contacted for additional information on their presentations. Papers were presented on the topics of remote sensing and sedimentary, igneous, and metamorphic host rocks. The individual papers were indexed for inclusion in the EDB Data Base.

42288 (GJBX—63(78)) **Preliminary classification of uranium deposits.** Mickle, D.G. (ed.). (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). May 1978. Contract EY-76-C-13-1664. 84p. Dep. NTIS, PC A05/MF A01.

For this classification, uranium deposits in sedimentary rocks are divided into two groups, syngenetic and epigenetic: syngenetic deposits are formed contemporaneously with deposition of the enclosing sediment; while epigenetic deposits are formed by precipitation of uranium from solutions moving through pre-existing rock or previously deposited sediment: The five classes of syngenetic deposits are as follows: placer, quartz-pebble conglomerate, marine black shale, phosphorite, and water. Epigenetic deposits include lignite, coal, and carbonaceous shale; evaporative precipitates; sandstone; and limestone.

EXPLORATION

REFER ALSO TO CITATION(S) 42287, 43503

42289 (GJBX—11(78)) **NURE 1977 annual activity report.** (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). May 1978. Contract-EY-76-C-13-1664. 91p. Dep. NTIS, PC A05/MF A01.

The most significant development in 1977 for NURE was planning, organizing, and initiating the quadrangle evaluation studies program for evaluating the uranium resources of U.S. The Aerial Radiometric Reconnaissance program and the Hydrogeochemical and Stream-Sediment Reconnaissance (HSSR) program schedules have been modified to coincide as nearly as possible with the quadrangle evaluation schedule. Six airborne contractors have provided 12 systems which have flown some 400,000 line miles of survey. In the HSSR program, sampling was completed in 60 quadrangles, with sampling underway in 25 additional quadrangles at the end of 1977. In the topical geological studies program, attention was given to those types of nonsandstone environments found throughout the world that might lead to the discovery of new uranium districts in U.S. In the technology development program, new calibration and test facilities were placed in operation for both borehole logging and airborne radiometric surveying systems. Fast and delayed fission systems for borehole logging are being field tested. Exploration system studies were initiated. Information dissemination is reported. (DLC)

42290 (GJBX—13(78)) **Manual for the application of NURE 1974—1977 aerial gamma-ray spectrometer data.** Saunders, D.F.; Potts, M.J. (Texas Instruments, Inc., Dallas (USA)). Sep 1977. Contract EY-76-C-13-1664. 184p. Dep. NTIS, PC A09/MF A01.

This manual was prepared as an aid to those interested in the interpretation and application of high-sensitivity aerial gamma-ray spectrometer data in uranium exploration. Particular emphasis is on the first 10 radiometric surveys performed under the National Uranium Resource Evaluation (NURE) program. The primary purpose of aerial gamma-ray spectrometer surveys in the NURE program is to map regional distributions of near-surface natural radioelements, i.e., the uranium and thorium decay series, and potassium-40. These data along with an understanding of the geochemical behavior of the pertinent isotopes under a variety of conditions allow uranium-enriched areas of the earth's crust (uraniferous provinces) to be identified as part of the regional appraisal phase of prospecting. Uranium ore deposits tend to occur more frequently in these generally enriched regions than elsewhere, and, consequently, uraniferous provinces constitute preferred territory for follow-up exploration methods such as detailed aerial or surface radiometric prospecting, geological studies, etc., to define potential prospects. These in turn may be investigated by still more detailed surface geological studies perhaps supplemented by radon or uranium geochemical surveys and exploration drilling and logging. This manual outlines the fundamentals of uranium geology and geochemistry along with interpretive approaches which may be used to identify statistically and geochemically significant uranium anomalies and uraniferous provinces. Follow-up prospecting methods are summarized along with guides to recent literature. Specific suggestions are made as to interpretive approaches and applicable follow-up prospecting procedures tailored to fit the data characteristics and general environment of each of the first 10 NURE aerial gamma-ray spectrometer surveys performed by Geodata International, Inc. and Texas Instruments Incorporated.

42291 (GJBX—20(78)-1) **Aerial gamma ray and magnetic survey: Fremont Quadrangle, Nebraska, Iowa; Lincoln Quadrangle, Nebraska; Manhattan Quadrangle, Kansas; Hutchinson Quadrangle, Kansas. Final report. Volume I.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Nov 1977. Contract EY-76-C-13-1664. 202p. Dep. NTIS, MF A01.

Portions of document are illegible.

A high sensitivity airborne radiometric and magnetic survey of the East Salina Basin Area (Kansas and Nebraska) was conducted. The project area, the Hutchinson and Manhattan, Kansas sheets, consists of approximately 30,800 square miles. A total of 11,287 line miles of high sensitivity radiometric and magnetic data were collected. All data were collected utilizing a fixed wing aircraft, and over 3,500 cubic inches of NaI crystal detector. Magnetometer data were collected utilizing a high sensitivity 0.25 gamma, proton magnetometer. All field data were returned to GeoMetrics, Sunnyvale, California computer facilities for processing, statistical analysis and interpretation. As an integral part of this final report, other data are presented which include corrected profiles of all radiometric variables (total count, K, U, Th, U/Th, U/K, and Th/K, ratios), magnetic data, radar altimeter data, barometric altimeter data, air temperature and airborne Bi contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are presented in the form of strip charts as averaged one second samples using a 5 second moving average window, microfiche and digital magnetic tapes containing raw spectral data, single record data, averaged record data, and statistical analysis results. In addition, computer generated anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric data.

42292 (GJBX—20(78)-2) **Aerial gamma ray and magnetic survey: Fremont Quadrangle, Nebraska, Iowa. Final report. Volume II.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Nov 1977. Contract EY-76-C-13-1664. 114p. Dep. NTIS, PC A06/MF A01.

Data from the aerial gamma ray and magnetic survey of the Fremont Quadrangle in Nebraska and Iowa are presented in the form of radiometric profiles, flight path recovery maps, anomaly maps, and histograms. (LK)

42293 (GJBX—20(78)-3) **Aerial gamma ray and magnetic survey: Lincoln Quadrangle, Nebraska. Final report. Volume II.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Nov 1977. Contract EY-76-C-13-1664. 176p. Dep. NTIS, PC A09/MF A01.

Data from the aerial gamma ray and magnetic survey of the Lincoln Quadrangle in Nebraska are presented in the form of radiometric profiles, flight path recovery maps, anomaly maps, and histograms. (LK)

42294 (GJBX—20(78)-4) **Aerial gamma ray and magnetic survey: Hutchinson Quadrangle, Kansas. Final report. Volume II.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Nov 1977. Contract EY-76-C-13-1664. 110p. Dep. NTIS, PC A06/MF A01.

Data from the aerial gamma ray and magnetic survey of the Hutchinson Quadrangle in Kansas are presented in the form of radiometric profiles, flight path recovery maps, anomaly maps, and histograms. (LK)

42295 (GJBX—20(78)-5) **Aerial gamma ray and magnetic survey: Manhattan Quadrangle, Kansas. Final report. Volume II.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Nov 1977. Contract EY-76-C-13-1664. 104p. Dep. NTIS, PC A06/MF A01.

Data from the aerial gamma ray and magnetic survey of the Manhattan Quadrangle in Kansas are presented in the form of radiometric profiles, flight path recovery maps, anomaly maps, and histograms. (LK)

42296 (LA—7175-PR) **Hydrogeochemical and stream sediment reconnaissance of the National Uranium Resource Evaluation Program: the Rocky Mountain States of New Mexico, Colorado, Wyoming, and Montana, and the State of Alaska. Progress report, October—December 1977.** Morris, W.A.; Bunker, M.E.; Steinhaus, D.W. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

Early in the quarter the scope of the HSSR for uranium was expanded by the DOE to include the analysis of thorium and lithium in sediment and several other elements selected by the LASL in either sediment or water. Development of the LASL multielement capabilities in the x-ray fluorescence, spectrochemical, and neutron activation techniques was accelerated to achieve the required throughput rate of 200 samples per day by each method early in FY

78. The LASL will report data for 43 elements in sediment samples and 13 elements in water samples. During the quarter, uranium analyses were determined for 7360 sediment samples and 7100 water samples. The priorities and format for HSSR reconnaissance reports were changed to reflect the new DOE guidance received early in the quarter. Reconnaissance report boundaries will coincide with those of NTMS 1:250,000-scale topographic map sheets; existing data bases are being split and combined to conform to these boundaries. Computer output formats and headers for the multielement listings to be used in LASL HSSR reports were developed and are ready to be used on the first multielement report. One reconnaissance report was open filed through the DOE Grand Junction Office. Two NTMS quadrangles were sampled as part of pilot studies; 39 of the 66 quadrangles assigned to the LASL in the lower 48 states have been completely sampled, and bid quotations were requested for sampling all or the remaining parts of the other 27 quadrangles during FY 78. Sampling specifications to be released for bid next quarter were prepared for the 35 quadrangles to be sampled in Alaska in FY 78.

42297 (LA—7177-MS) **Uranium hydrogeochemical and stream sediment reconnaissance of the Denver and Greeley NTMS Quadrangles, Colorado.** Bolivar, S.L.; Broxton, D.E.; Olsen, C.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 267p. Dep. NTIS, PC A12/MF A01.

Although this report covers two National Topographic Map Series 2° quadrangles, the data for each quadrangle are presented separately. Evaluation of the data by quadrangle resulted in the delineation of areas in which water and/or sediment uranium concentrations are notably higher than surrounding background concentrations. The major clusters of anomalous water samples were found in areas of the Denver Basin underlain by the Pierre, Laramie, Fox Hills, Denver, and Arapahoe formations. Most of the anomalous sediment samples were collected in areas of the Front Range underlain by Precambrian crystalline rocks, particularly granites of the Silver Plume-Sherman group. Many of the anomalous sediment samples are from sites located near fault zones. The data in this report are also presented by geologic/physiographic province because background uranium concentrations in Front Range samples differ significantly from those in the Denver Basin. Denver Basin waters have higher mean uranium concentrations (mean 14.4 ppB) than Front Range waters (mean 3.3 ppB). Conversely, Front Range sediments are more uraniferous (mean 14.7 ppM) than those in the Denver Basin (mean 6.1 ppM). These differences in background uranium concentrations between Front Range and Denver Basin samples can be attributed to differences in regional geology, physiography, and (in the case of water) the ratio of surface water to ground water sites sampled. There is a significant northward increase in uranium concentrations in water samples from the Denver Basin. The higher uranium concentrations in water samples from the northern part of the basin are probably due to leaching of uraniferous strata in the Pierre and Laramie formations which crop out in that area.

42298 (LA—7181-MS) **Uranium hydrogeochemical and stream sediment reconnaissance data release for the Wyoming portions of the Driggs, Preston, and Ogden NTMS Quadrangles.** Broxton, D.E.; Nunes, H.P. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 201p. (GJBX—70). Dep. NTIS, PC A10/MF A01.

This report describes work done in the Wyoming portions of the Driggs and Preston, Wyoming/Idaho, and the Ogden, Wyoming/Utah, National Topographic Map Series (NTMS) quadrangles (1 : 250,000 scale) by the Los Alamos Scientific Laboratory (LASL) as part of the nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). The HSSR is designed to identify areas having higher than normal concentrations of uranium in ground waters, surface waters, and water-transported sediments. During the fall of 1976, 1108 water samples and 1956 sediment samples were taken from 1999 locations by a private contractor within the Wyoming portion of Driggs, Preston, and Ogden quadrangles. An additional 108 water samples and 128 sediment samples were collected in the Grand Teton National Park during the fall of 1977 by staff members from the LASL. All of the samples were collected and treated according to standard specifications described in Appendix A. Uranium concentrations were determined at the LASL using standard analytical methods and procedures, also described briefly in Appendix A. Appendixes B-I through B-III and C-I through C-III are listings of all field and analytical data for the water and sediment samples, respectively. Appendixes D-I and D-II provide keys to codes used in the data listings. Statistical data describing the mean, range, and standard deviations of uranium concentrations are summarized by quadrangle and sample source-type in Tables I through III.

42299 (LBL—7029) **Uranium in alkaline rocks.** Murphy, M.; Wollenberg, H.; Strisower, B.; Bowman, H.; Flexser, S.; Carmichael, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Apr 1978. Contract W-7405-ENG-48. 192p. Dep. NTIS, E05/MF E05.

Geologic and geochemical criteria were developed for the occurrence of economic uranium deposits in alkaline igneous rocks. A literature search, a limited chemical analytical program, and visits to three prominent alkaline-rock localities (Ilimaussaq, Greenland; Pocos de Caldas, Brazil; and Powderhorn, Colorado) were made to establish criteria to determine if a site had some uranium resource potential. From the literature, four alkaline-intrusive occurrences of differing character were identified as type-localities for uranium mineralization, and the important aspects of these localities were described. These characteristics were used to categorize and evaluate U.S. occurrences. The literature search disclosed 69 U.S. sites, encompassing nepheline syenite, alkaline granite, and carbonatite. It was possible to compare two-thirds of these sites to the type localities. A ranking system identified ten of the sites as most likely to have uranium resource potential.

42300 **Applied mineral exploration with special reference to uranium.** Bailey, R.V.; Childers, M.O. Boulder, CO; Westview Press, Inc. (1977). 561p. $65.00.

An explanation of the fundamentals of organizing, operating, and concluding an exploration program, particularly uranium exploration, is presented. Discussion of many exploration practices currently being used in the industry and a review of some new developments or research projects which are being studied or which show promise are included. The material is presented in 13 chapters entitled: the Mineral Explorationist and the Role He Plays; Types of Uranium Deposits; Development of Idea and Preliminary Investigation: Uranium; a Review of Mining Law as it Pertains to Mineral Exploration and Development in the United States; Land Ownership and Leasing; Continuing Detailed Geologic Work; the Decision to Make a Play; Selling a Deal; Legal and Accounting Aspects; the Drilling Program; Using Geology in Planning and Executing Drilling; Transition from Exploration to Development; and a Forward Look.

42301 (UCRL-Trans—11361) **Anomaly in the even-numbered isotopes of uranium in subsurface waters of seismically active regions of Georgia.** Zverev, V.L.; Dolidze, N.I.; Spiridonov, A.I.; Cheshko, A.L.; Chkhenkeli, Sh.M. Translated from *Geokhimiya;* No. 11, 1720-1724(1975). 11p.

The nature of uranium isotope distribution as well as the uranium and radium content in the subsurface waters of the seismically active regions of South Georgia were studied. A difference in the isotopic composition for uranium in the subsurface waters of the Akhaltsikhskii artesian basin and the Dzhavakhetskaya zone was demonstrated. A substantial excess of ^{234}U was found in the waters of the Dzhavakhetskaya zone (up to $\gamma = 11.0 +- 0.9$), which is apparently caused by the effect of the specific tectonic conditions of the region. A change was found in the ratio of uranium isotopes and the concentration of radium in the subsurface waters during seismic activity in the region of the Dzhavakhetskaya folded zone. The results from the investigations performed suggest a need to organize routine observations of natural isotopic-geochemical variations.

42302 **Data-management and analysis systems for large-scale hydrogeochemical reconnaissance.** Ferguson, R.B.; Maddox, J.H.; Wren, H.F. (Savannah River Lab., Aiken, SC). *Comput. Geosci.;* 3: 453-458(1974).

The Savannah River Laboratory has developed a versatile, computerized data recording, processing, updating, and retrieval system for handling an expected 150 million bytes of hydrogeochemical data from 150,000 to 200,000 sample sites through the next four years. A subsystem accounts for the movements of samples from initial receipt through final storage. Approximately 6 million sample movements are expected. Two- and three-dimensional plots of sampled geographic areas showing concentrations and locations of individual chemical elements are displayed and reproduced photographically. Pattern recognition techniques enable multivariate data to be categorized into "clusters" which indicate sites favorable for uranium exploration.

FEED PROCESSING

42303 (RFP-Trans—245) **Calcination system for reducing uranium compounds to UO_2 powder.** Cole, E.A.; Peterson, R.S. May 1978. Translation of German Patent 24 59 290. 12p. Dep. NTIS, PC A02/MF A01.

The invention concerns the production of UO_2 for reactor fuel assemblies, especially invariable and economical calcination of reducible reactive uranium compounds such as ammonium diuranate, for production of UO_2 with an oxygen-to-uranium atomic ratio of less than 2.2. Details of the calcination system are given. (LK)

ENRICHMENT

REFER ALSO TO CITATION(S) 42330

CENTRIFUGATION

42304 SIMOVERT intermediary circuit inverters for the enrichment of uranium with gas ultra centrifuges. Neupauer, H. (Siemens A.G., Erlangen (Germany, F.R.). Abt. ESTE); Weyer, H. (Siemens A.G., Erlangen (Germany, F.R.). Bereich Verkehr und Oeffentliche Auftraggeber). *Siemens-Z.;* **51**: No. 11, 903-907(Nov 1977). (In German).

The SIMOVERT intermediary circuit inverter (medium frequency, power 3 MW) operated with centrifuges is today a matured series equipment with a high standard of development which has proved itself manifold with over 50,000 inversion operation hours under various conditions. It fulfills the requirements for low component expenditure, high degree of economy and availability, and due to its suitability to powers up to the megawatt region at high efficiency, it also compares with the trend for larger centrifuge cascades.

LASER EXCITATION

42305 Method for isotope separation by photodeflection. Bernhardt, A.F. (to Energy Research and Development Administration). US Patent 4,063,090. 13 Dec 1977. Filed date 30 Oct 1974. 6p. PAT-APPL-519,706.

In the method of separating isotopes wherein a desired isotope species is selectively deflected out of a beam of mixed isotopes by irradiating the beam with a directed beam of light of narrowly defined frequency which is selectively absorbed by the desired species, the improvement comprising irradiating the deflected beam with light from other light sources whose frequencies are selected to cause the depopulation of any metastable excited states.

42306 Infrared laser system. Cantrell, C.D.; Carbone, R.J. (to Energy Research and Development Administration). US Patent 4,061,921. 6 Dec 1977. Filed date 2 May 1974. 10p. PAT-APPL-466,583.

An infrared laser system and method for isotope separation may comprise a molecular gas laser oscillator to produce a laser beam at a first wavelength, Raman spin flip means for shifting the laser to a second wavelength, a molecular gas laser amplifier to amplify said second wavelength laser beam to high power, and optical means for directing the second wavelength, high power laser beam against a desired isotope for selective excitation thereof in a mixture with other isotopes. The optical means may include a medium which shifts the second wavelength high power laser beam to a third wavelength, high power laser beam at a wavelength coincidental with a corresponding vibrational state of said isotope and which is different from vibrational states of other isotopes in the gas mixture.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 42347

42307 Design of facilities for processing pyrophoric radioactive material. Bristow, H.A.S.; Hunter, S.D. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). pp 173-180 of Design of and equipment for hot laboratories. Proceedings of a symposium organized by the IAEA and held in Otaniemi, Finland, 2-6 August 1976. Vienna; IAEA (1976).

From Symposium on the design of and equipment for hot laboratories; Otaniemi, Finland (2 Aug 1976).

See CONF-760811—.

The safe processing of large quantities of plutonium-bearing material poses difficult problems the solution of which sometimes involves conflicting requirements. The difficulties are increased when plutonium of a high burnup is used and the position becomes considerably more complicated when the chemical nature of the material being handled is such that it is pyrophoric. This paper describes the design principles and methods used to establish a facility capable of manufacturing large quantities of mixed plutonium/uranium carbide. The facility which included process stages such as milling, granulation, pellet pressing, furnacing and pin filling, was largely a conversion of an existing processing line. The paper treats the major plant hazards individually and indicates the methods used to counter them, outlining the main design principles employed and describing their application to selected items of equipment. Examples of the problems encountered with typical items of equipment are discussed. Some guide-lines are listed which should be of general value to designers and developers working on equipment for processing plutonium-bearing solids. The methods described have been successfully employed to provide a plant for the manufacture of mixed plutonium/uranium carbide on a scale of many hundreds of kilograms with no serious incident.

SPENT FUELS REPROCESSING

42308 (DOE/ET—0040/3) **Barnwell Nuclear Fuels Plant applicability study. Volume III. Appendices.** (Department of Energy, Washington, D.C. (USA). Office of Energy Technology). Mar 1978. 687p. Dep. NTIS, PC A99/MF A01.

Volume III suppliees supporting information to assist Congress in making a decision on the optimum utilization of the Barnwell Nuclear Fuels Plant. Included are applicable fuel cycle policies; properties of reference fuels; description and evaluation of alternative operational (flue cycle) modes; description and evaluation of safeguards systems and techniques; description and evaluation of spiking technology; waste and waste solidification evaluation; and Department of Energy programs relating to nonproliferation. (LK)

42309 (DP—1485) **Exothermic reactions leading to unexpected meltdown of scrap uranium—aluminum cermet cores during outgassing.** Gray, L.W.; Kerrigan, W.J. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Mar 1978. Contract EY-76-C-09-0001. 38p. Dep. NTIS, PC A03/MF A01.

During routine outgassing of scrap uranium-aluminum cermet cores, unexpected exothermic reactions released sufficient energy to melt nine cores. In the subsequent investigation, compounds in the scrap uranium were identified, the history of the material was defined, and thermal analysis studies were made. The incident was initiated by reactions at approximately 350°C between powdered aluminum metal and sodium uranate salt, $Na_2U_2O_7$. These reactions released sufficient energy to initiate aluminothermic reduction of $(NH_4)_3UO_2F_5$, $NaNO_3$, UO_3, and U_3O_8. The energy release from aluminothermic reduction reactions was sufficient to melt the cermet cores.

42310 (IAEA-AG—63-4) **Fast reactor fuel reprocessing in the United Kingdom.** Pugh, O. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 7p. (CONF-760576—28). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The reprocessing activities at Dounreay in the United Kingdom is presented. In 1958 a plant was built to permit recycling of unburnt ^{235}U from the U/Mo metallic fuel element used in the Dounreay Fast Reactor (DFR). The decision to reprocess the irradiated Pu/U oxide fuel from PFR at Dounreay to provide data for the construction of larger reprocessing plants required for commercial fast reactor exploitation, has required considerable modification of the present DFR plant. The modifications include fuel handling, containment and waste management. Special attention is also paid to problems connected with solvent extraction. A brief description of the practical measures taken to carry out the modifications is given.

42311 (IAEA-AG—63-5) **Reprocessing of "fast" fuel in France.** Sauteron, J.; Boudry, J.C.; Bourgeois, M.; Le Bouhellec, J.; Miquel, P. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 18p. (In French). Dep. NTIS (US Sales Only), PC A03/MF A01.

The results of laboratory studies as well as pilot testing (AT-I La Hague, Marcoule, Fontenay-aux-Roses) in reprocessing of fast breeder reactor fuels are described. The paper covers all steps: head end, aqueous and fluoride volatility processes, and waste treatment. In conclusion, it is demonstrated why it is still too early to define a strategy of industrial reprocessing for this reactor type.

42312 (IAEA-AG—63-6) **Development and status of LMFBR fuel reprocessing in the Federal Republic of Germany.** Baumgaertner, F.; Ochsenfeld, W. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 28p. (CONF-760576—19). Dep. NTIS (US Sales Only), PC A03/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The problems associated with reprocessing oxide LMFBR fuel elements result from the higher plutonium content, the higher fission product content and the higher level of thermal decay power; their consequences on the Purex process are well recognizable. Reprocessing LMFBR elements by the conventional Purex process technique is considered to be feasible. If the cooling time of LMFBR fuel elements amount to one year or more, it is only the higher plutonium content which determines the process flowsheet. The necessary chemical steps for reprocessing co-precipitated oxides have been developed at Karlsruhe for this case. The mechanical head end still needs to be developed on a technical scale, as does the management of safety against criticality. If reprocessing is to follow

a cooling time of less than 200 days, as envisaged in the original planning for LMFBR fuel elements, the efficiency of offgas treatment and the reliable operation of fast contactors in the first extraction cycle still have to be tested.

42313 (IAEA-AG—63-7) **Considerations on the gamma activity of the Pu product arising from LMFBR's fuel reprocessing.** Moccia, A. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 5p. (CONF-760576—26). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The composition of Pu product and its gamma activity and gamma power were theoretically calculated with reference to the fuel to be recovered from the PEC fast experimental reactor. Preliminary evaluation derived from this calculation allows some conclusions to be drawn related to the extent of the purification from fission products required in the reprocessing step.

42314 (IAEA-AG—63-8) **Head-end and nuclear gas purification research on LMFBR fuel reprocessing in Belgium.** Baetsle, L.H. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 11p. (CONF-760576—18). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

In the framework of the international DEBENELUX project on fast reactor development considerable attention was devoted to the reprocessing problems. The report describes the specific Belgian contributions which were focussed on experimental and conceptual studies of de-activation and transportation, on dissolution of high burn-up MOX fuel, and on technological development of gas purification methods applicable to LMFBR fuel.

42315 (IAEA-AG—63-9) **Research and development of FBR fuel reprocessing in PNC.** Hoshino, T. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 9p. (CONF-760576—22). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The research program of the PNC for FBR fuel reprocessing in Japan is discussed. The general characteristics of FBR fuel reprocessing are pointed out and a comparison with LWR fuel is made. The R and D program is based on reprocessing using the aqueous Purex process. So far, some preliminary steps of the research program have been carried out, these include solvent extraction test, offgas treatment test, voloxidation process study, solidification test of high-level liquid waste, and study of the dissolution behaviour of irradiated mixed oxide fuel. By the end of the 1980s, a pilot plant for FBR fuel reprocessing will be completed. For the design of the pilot plant, further research will be carried out in the following fields: head-end techniques; voloxidation process; dissolution and extraction techniques; waste treatment techniques. A time schedule for the different steps of the program is included.

42316 (IAEA-AG—63-10) **Feasibility study for adapting ITREC plant to reprocessing LMFBR fuels.** Moccia, A.; Rolandi, G. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 20p. (CONF-760576—27). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The report evaluates the feasibility of adapting ITREC plant to the reprocessing LMFBR fuels, with the double purpose of: 1) recovering valuable Pu contained in these fuels and recycling it to the fabrication plant; 2) trying, on a pilot scale, the chemical process technology to be applied in a future industrial plant for reprocessing the fuel elements discharged from fast breeder power reactors.

42317 (IAEA-AG—63-11) **Studies on fluoride volatility process for the reprocessing of LMFBR fuels.** Chijiya, M. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 3p. (CONF-760576—21). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

Some technical problems of the Fluoride Volatility Process for reprocessing spent fuels from FBR reactors are dealt with. Studies on the process are carried out by the Japan Atomic Energy Research Institute, and some results concerning the fluorination and purification steps of the process are summarized briefly.

42318 (IAEA-AG—63-16) **Thermal decladding of BOR-60 fuel elements.** Bibikov, S.E.; Vasil'ev, G.I.; Ivanov, P.M.; Novoselov, G.P.; Serov, A.V.; Skiba, O.V.; Barkov, V.A. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 20p. (In Russian). (CONF-760576—31). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

Experimental results on thermal decladding of reactor BOR-60 fuel elements irradiated to >10% and cooling time - 6 and 3 months - are discussed. The direct yield of fuel is 99.9%; content of steel in fuel <5.4%; data on fission products distribution are also given.

42319 (IAEA-AG—63-26) **Process equipment for some operations in reprocessing fast reactor fuels.** Mitrofanov, Yu.A.; Davydov, V.I.; Tyul'pa, A.G. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 10p. (In Russian). (CONF-760576—35). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The paper describes the results achieved in the development and utilization of: drum dissolver with internal screw elevater; catridge filter with porous titanium (porous diameter 7-12 microns); installation for vitrification of liquid waste, which consists of an evaporator, drying calciner, melter and gas-off cleaning system.

42320 (IAEA-AG—63-27) **Report of the IAEA advisory group meeting on LMFBR fuel reprocessing.** (International Atomic Energy Agency, Vienna (Austria)). May 1976. 31p. (CONF-760576—23). Dep. NTIS (US Sales Only), PC A03/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

A summary of the papers and discussions of the meeting is presented, reviewing the status of development in LMFBR fuel reprocessing and focusing attention on important problem areas. The following topics are discussed: Transport, storage and removal of sodium; decladding and shearing; dissolution; Purex process; fluoride volatility method; off-gas purification; waste disposal. Status reports of national programes of Belgium, France, Federal Republic of Germany, Italy, Japan, United Kingdom, USSR and USA are included.

42321 (NIIAR-P—17(283)) **Decladding of BOR-60 and BR-5 fuel elements by clad melting.** Barkov, V.A.; Bibikov, S.E.; Vasil'ev, G.I.; Ivanov, P.M.; Novoselov, G.P.; Pakhomov, V.V.; Serov, A.V.; Skiba, O.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1976. 16p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Experiments have been carried out on thermal decladding of irradiated oxide fuel elements of BOR-60 reactors (maximum burning 11%, exposure 6 and 3 months) and BR reactors (burning up to 5%, exposure 13 years). Uranium yield during decladding has been 99.9%, that of plutonium - 98.8%, steel concentration in the opened fuel - 5% and less. The physical condition of the fuel after the fuel element casing has been removed does not show any variations. The oxide fuel is shown to give up to 80% cesium, and partially iodine on heating up to 1870°K, while other splinter elements evolve in insignificant amounts.

42322 (RFP—2770) **Tributyl phosphate impregnated sorbent for plutonium—uranium separation.** Alford, C.E.; Navratil, J.D. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 31 Mar 1978. Contract EY-76-C-04-3533. 11p. (CONF-780452—1). Dep. NTIS, PC A02/MF A01.

From Colorado-Wyoming academy of sciences meeting; Pueblo, CO, USA (21 Apr 1978).

Portions of document are illegible.

Extraction, or reverse-phase partition chromatography, as used mostly for analytical separations, employs an organic solvent extractant as a stationary phase on an inert support material. This technique has the advantage of utilizing the versatility of solvent extraction systems with the less expensive operation of ion exchange equipment. Bayer AG Lewatit OC-1023, a tributyl phosphate impregnated sorbent developed for extraction chromatography, was evaluated for the separation of uranium and plutonium from mixed actinide residues at Rocky Flats. Uranium breakthrough capacity and eluion behavior were determined for the OC-1023. Uranium breakthrough capacity results show that the support has a high capacity for uranium from 10 g/l uranium and 25 g/l plutonium-2.5 g/l uranium feeds. The total uranium capacity of the support under these conditions was determined to range from about 53 to 65% of the theoretical TBP capacity. The uranium elution results show that the uranium can be eluted with a minimum of eluant.

42323 **Politics of nuclear safety.** Wynne, B. (Lancaster Univ. (UK)). *New Sci.;* 77: No. 1087, 208-211(26 Jan 1978).

The recent Windscale inquiry, concerning the building of a new plant for reprocessing nuclear fuel, highlighted the wider issues of environmental pollution and radiological protection. In particular the discrepancies between the various crucial safety standards governing nuclear plants were exposed. These standards and the institutions which set them are examined. The tensions which prevail between the nuclear industry, the authorities and the public in the

UK are discussed. It is felt that the option of greater openness in public relations although more difficult in the short term, will turn out to be the more pragmatic policy from the industry's point of view.

42324 Safety aspects of non-process media supply in a reprocessing plant, illustrated by the example of WAK cooling water supply. Boehmer, V.; Grein, W. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). pp 286-289 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 2. Sicherheit kerntechnischer Anlagen. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

Investigations of the 'safety relevance' of element and component failures are of decisive importance in technical systems, in particular in nuclear engineering. However, while there is already a number of regulations and guidelines for LWR reactors, no such regulations have been in existence for reprocessing plants so far. Therefore, 'application in the general sense' is required in practice. This is explicitly shown using the example of coolant supply failure at the WAK.

42325 Method for shearing spent nuclear fuel assemblies. Weil, B.S.; Watson, C.D. (to Energy Research and Development Administration). US Patent 4,056,052. 1 Nov 1977. Filed date 29 Apr 1976. 8p.

PAT-APPL-681,648.

A method is disclosed for shearing spent nuclear fuel assemblies of the type wherein a plurality of long metal tubes packed with ceramic fuel are supported in a spaced apart relationship within an outer metal shell or shroud which provides structural support to the assembly. Spent nuclear fuel assemblies are first compacted in a stepwise manner between specially designed gag-compactors and then sheared into short segments amenable to chemical processing by shear blades contoured to mate with the compacted surface of the fuel assembly.

42326 Equipment and instrumentation of a laboratory for Purex process analytical chemistry. Erte, D. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Heisse Chemie). pp 159-164 of Design of and equipment for hot laboratories. Proceedings of a symposium organized by the IAEA and held in Otaniemi, Finland, 2-6 August 1976. Vienna; IAEA (1976).

From Symposium on the design of and equipment for hot laboratories; Otaniemi, Finland (2 Aug 1976).

See CONF-760811—.

By the example of the process analytical service for the small-scale MILLI reprocessing facility a description is given of the underlying prerequisites such as laboratory equipment, working conditions and safety precautions. In addition, the fundamentals of analytical instrumentation and associated problems are discussed and finally some facts are presented which result from several years of practical experience.

TRANSPORT AND STORAGE

42327 (IAEA-AG—63-15) **Fast reactor spent fuels transportation problems.** Burlakov, V.A.; Kosarev, Yu.A.; Markovin, A.P. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 6p. (In Russian). (CONF-760576—33). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

In this paper transportation problems of spent fuels from fast reactors BN-350, BN-600 and BN-1500 to reprocessing plant are discussed. It was calculated that 6-10 fuel assemblies can be inserted in one transport cask, the weight of which is 50-60t. Noble gas or water can be used for the BN-350 fuel cask; sodium, lead and special alloys for the BN-1500. Transportation problems of angermetized fuel are also considered in this paper.

42328 (RFP—2728) **National Waste Terminal Storage Program: low level transuranic waste transportation studies.** Merlini, R.J.; Rushton, R.J.; Briggs, W.R. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 3 Apr 1978. Contract EY-76-C-04-3533. 37p. Dep. NTIS, PC A03/MF A01.

This study was performed to identify transportation related problems and concerns for low-level transuranic (LLT) wastes. Recommended actions for these problems and concerns are included.

42329 Transportation issues. Trosten, L.M. Washington, DC; Atomic Industrial Forum, Inc. (1977). 18p. (CONF-7705116—2).

From AIF's workshop on insurance; Atlanta, GA, USA (8 May 1977).

The "omnibus" features of the Price—Anderson insurance-indemnity system are described. The position of rail carriers on the coverage of transportation incidents is considered. Their arguments that the coverage is not adequate and that therefore they do not have to transport radioactive materials are shown to be without foundation. (DLC)

MARKETING AND ECONOMICS

42330 (ORO—759) **Uranium Enrichment Services Activity. Financial statements for period ended September 30, 1977.** (Department of Energy, Washington, D.C. (USA)). 31 Mar 1978. 16p. ORO.

The balance sheet, income statement, changes in government investment, statement of changes in financial position, and notes to financial statements are provided. Schedules containing details of separative work inventories, plant and equipment, cost of production and sales, and power costs are included. (LK)

42331 (PB—274829) **Uranium enrichment policies and operations: status and future needs. Report to the congress.** (General Accounting Office, Washington, D.C. (USA). Energy and Minerals Div.). 18 Nov 1977. 65p. (EMD—77-64). NTIS PC A04/MF A01.

The three Government-owned uranium enrichment plants are the world's primary source of enrichment services. These plants prepare uranium for use as nuclear reactor fuel. The need for, and timing of, future plants depends largely on nuclear power growth, the U.S. share of the foreign enrichment services market, and the use of existing plants and enriched uranium supplies. GAO recommends that the Department of Energy evaluate several options for extending this Nation's enrichment capacity. Other GAO recommendations are aimed at improving policies on (1) the enriched uranium stockpile, (2) uranium imports, (3) the ability to meet additional contract demand, and (4) uranium pricing.

WASTE MANAGEMENT

42332 Safety. Fremlin, J.H. (Birmingham Univ. (UK)). pp 73-76 of Breeder reactor. Forrest, J.S. (ed.). Edinburgh; Scottish Academic Press (1977).

From Meeting on the breeder reactor; Strathclyde, UK (25 Mar 1977).

A quantitative discussion is given of the magnitude of the risks arising from the management of the radioactive wastes from nuclear power stations. The main hazard arising from current operations in Britain is shown to be due to the liquid effluents from the processing plant at Windscale. These are run out into the Irish Sea and cause contamination of the mud of the Ravenglass Estuary and of the bottom-dwelling edible fish off the Cumbrian coast. The latter are the more important and absorb significant quantities of caesium 137. The risk to an individual eating such fish is small but if the present rate of emission of ^{137}Cs continued indefinitely the deaths from cancer of a few people per decade would eventually be produced among British consumers. This is shown to be less than one hundred-thousandth of the cancers produced in Britain by other environmental causes. The final disposal is discussed of high-level fission-product wastes contaminated with plutonium and other actinides. The advantages of keeping these in solution under supervision in cooled tanks for a few decades is explained and the glassification for final disposal underground described. It is pointed out that the glassified blocks will be dangerous to approach closely for a few hundred years, but that the much longer-lived alpha activity due to the actinides could affect human beings only if the glass were ground up and ingested. The blocks are insoluble in water and will therefore offer no significant risk if buried in any reasonably deep hole whether this is wet or dry.

42333 Management of wastes from the mining and milling of uranium and thorium ores. A code of practice and guide to the code. Vienna; IAEA (1976). 50p.

The first part is the Code of Practice approved by the Board of Governors of the IAEA in June 1976 as part of the Agency's safety standards, which are applied to those operations undertaken by Member States with the assistance of the Agency. The following topics are concerned: 1) Responsibilities. 2) Environmental considerations affecting siting and discharge limits. 3) Wastes requiring management. 4) Mine wastes. 5) Mill wastes. 6) In-situ leaching wastes. 7) Decommissioning requirements. 8) Financial arrangements. 9) Periodic inspections of wastes and the environment. 10) Transfer of ownership. The second part, the Guide to the Code, indicates ways in which the requirements of the Code may be met. The information reflects current best available technology. This technology was considered to provide an acceptable degree of safety.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 42314, 42372

42334 (IAEA-AG—63-2) **Retention of gaseous fission products in reprocessing LMFBR fuels.** Burch, W.D.; Yarbro, O.O.; Groenier, W.S.; Stephenson, M.J. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 35p. (CONF-760576—20). Dep. NTIS (US Sales Only), PC A03/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The report is devoted to status of the development program at the Oak Ridge National Laboratory on methods for retaining iodine-131 and 129, Krypton-85, Tritium and Carbon-14 in reprocessing LMFBR fuels. The Iodox process, Fluorocarbon absorption process and Voloxidation process are described for retention of iodine, Krypton-85 and Tritium, respectively. Flowsheets for the different processes are given and results of experimental runs in small engineering-scale equipment are reported.

42335 (KBS-TR—01) **Radionuclide inventories in PWR spent fuel and high-level waste calculated by use of the ORIGEN code.** Kjellbert, N. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Apr 1977. 68p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

Radionuclide inventories in PWR spent fuel and high-level waste have been computed. Apart from fission products and heavy nuclides the activation products emanating from the cladding have been included for the spent fuel case. As times-to-reprocessing 1, 3, and 10 years of cooling have been used and the inventories have been calculated for times from 1 year through 10^7 years after shutdown.(author).

42336 (KFK-tr—541) **Continuous vitrification of concentrated fission product solutions.** Jouan, A.; Sombret, C. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Internationales Buero/Uebersetzergruppe). Oct 1977. 23p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

Converting fission product solutions into a solid, vitrified product for safe ultimate storage is the approach pursued by France in the treatment of this type of waste. The continuous vitrification technique developed by the CEA for the conversion of fission product solutions at the same time helps to greatly reduce the volume of such solutions. The equipment used for this purpose, i.e., a rotary calciner for calcination of the solution and a melting furnace for vitrification of the calcination product, is described in the article. The results of experiments conducted on the equipment in a prototype system built at the Marcoule Nuclear Research Center for a total of approximately 7,400 hours are reported and discussed. Also a new vitrification furnace is described which operates by direct induction in the molten glass. Thanks to the satisfactory results achieved with respect to performance and reliability of the equipment, the development of this line has been extended up to the industrial scale. A system employing this principle has been set up on the Marcoule site.

42337 (LA—7246-PR) **Experimental studies of the degradation of RAD-wastes for the Sandia Laboratories Waste Isolation Pilot Project (WIPP). Progress report, October 1—December 31, 1977.** Zerwekh, A.; Kosiewicz, S. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

An experimental program was started to determine the effects of radiolytic, thermal, catalyzed pyrolytic, and chemical degradation mechanisms on various forms of existing or proposed transuranic (TRU) wastes. Pressure vessels were designed to study the degradation of various TRU waste matrices at Waste Isolation Pilot Project (WIPP) lithostatic pressure at various temperature and contamination levels. "Worst case" screening experiments are under way to determine gas and water yields from radiolytic, thermal, and pyrolytic degradations, with and without catalysts present. A high-temperature thermobalance, modified and tested for low-temperature work, is being used effectively in these experiments. The lowest decomposition temperature measured to date was 150°C, well above the 70°C maximum expected in WIPP.

42338 (LA-UR—78-1065) **Controlled-air incineration studies at the Los Alamos Scientific Laboratory.** Borduin, L.C.; Neuls, A.S.; Thompson, T.K.; Warner, C.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 19p. (CONF-780316—10). Dep. NTIS, PC A02/MF A01.

From Waste management fuel cycles; Tucson, AZ, USA (5 Mar 1978).

An overview of the LASL controlled-air incineration (CAI) program is provided through a description of the process, a summary of component selection and system design criteria, a statement of project status, and discussion of experimental and process improvement study plans. The results of the program will be used to formulate the design criteria and operating parameters for a production model controlled-air transuranic (TRU) waste incineration system and govern the construction and operation of a facility for this purpose. The objective of the LASL CAI project is to develop and demonstrate an effective, safe, and reliable process for volume reduction and chemical stabilization of TRU solid wastes using proven technology whenever possible. The benefits of this process will be realized in reduced handling and storage hazards potentials, lower packaging, transportation, and storage expenses, less storage space requirements, and fewer monitoring needs.

42339 **Treatment and disposal of liquid waste in the nuclear power industry.** Lewis, J.B. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). *Atom (London);* No. 255, 8-15(Jan 1978).

Paper presented by the head of the Industrial Chemistry Group at AERE Harwell at a symposium held by the University of Newcastle upon Tyne (UK) in association with the Institute of Water Pollution Control and the Institution of Chemical Engineers in September 1977. Main headings are as follows: general introduction; units of measurement of radioactivity; environmental considerations (disposal authorisations, natural background, critical path approach, discharges to the sea, discharges to rivers); types of liquid waste (general, high level wastes, wastes from chemical processing stages, wastes from nuclear power stations, miscellaneous wastes); treatment techniques (general, evaporation, chemical precipitation, ion exchange, reverse osmosis, electrodialysis); disposal of radioactive concentrates (high level wastes, sludges, exhausted ion exchangers, etc.). It is concluded that the main task remaining is to find the best means of ultimate disposal of high level wastes.

42340 **Nuclear waste solidification.** Bjorklund, W.J. (to Energy Research and Development Administration). US Patent 4,065,400. 27 Dec 1977. Filed date 8 Apr 1976. 8p.

PAT-APPL-675,086.

High level liquid waste solidification is achieved on a continuous basis by atomizing the liquid waste and introducing the atomized liquid waste into a reaction chamber including a fluidized, heated inert bed to effect calcination of the atomized waste and removal of the calcined waste by overflow removal and by attrition and elutriation from the reaction chamber, and feeding additional inert bed particles to the fluidized bed to maintain the inert bed composition.

42341 **Nuclear fuel cycle, (6) waste treatment and storage.** Corbet, A.D.W. (British Nuclear Fuels Ltd., Risley). *J. Inst. Fuel;* 173-178(Dec 1977).

The origins of radioactive waste, both natural and artificial, are identified. Radiological protection standards are discussed in relation to natural background levels. The role of the International Commission on Radiological Protection is considered together with derived national standards of protection for the public in the UK. For illustration, one kilowatt-year of electricity generated by nuclear fission (splitting of ^{238}U atoms) is considered and attention is drawn to the very small quantities of nuclear waste created compared with the corresponding quantities of fossil fuel. The characteristics of the radioactive emissions from the various wastes are outlined in order to categorize the hazards and the precautions which have to be taken against them. Principles governing the management of waste and how these affect treatment and storage processes are considered. A very important characteristic of most of the radioactivity created during the production of nuclear power is its very rapid rate of decay. In many cases interim storage is practical so as to reduce radiotoxicity before disposal into the environment. Virtually all the residual radioactivity from irradiated (spent) fuel is segregated, concentrated and stored as highly active liquid waste. Various industrial processes have or are being developed to immobilize this waste into suitable forms both for ease of storage and subsequent disposal. Three types of practical disposal locations are being considered. These will ensure that at the worst only insignificant quantities of radioactivity can return to man.

42342 **Bituminization of concentrated radioactive wastes.** Napravnik, J.; Dlouhy, Z. *Jad. Energ.;* **23**: No. 5, 184-193(May 1977). (In Czech).

The technology of radioactive waste fixation in bitumen is assessed, and the conditions under which the method may be used industrially are critically evaluated. The types of bitumens used and their classification according to their physico-chemical properties are indicated. The decisive factors for the choice of the method include the effect of ionizing radiation on the product properties, leachibility of radionuclides from the product, the effect of nitrates on the product properties during the process, and product behavior during storage. Mixing of solid and liquid radioactive wastes with bitumen emulsion proceeds at a temperature of 25°C, with molten bitumen at a temperature of 160 to 250°C while water and volatile components are evaporated from the mixture. Technologies used in the USA, France, Belgium, the United Kingdom, FRG, and USSR are described and their advantages and constraints summed up.

42343 Method for the separation and extraction of radioactive krypton and xenon isotopes from waste gases. Schroeter, H.J.; Knoblauch, K.; Juentgen, H. (to Bergwerksverband G.m.b.H., Essen (Germany, F.R.)). German(FRG) Patent 2,210,264/B/. 3 Mar 1977. 7p. (In German).

A method is described enabling the separation of radioactive krypton and xenon isotopes from the waste gases of nuclear facilities and then the separation of both of these. The waste gas at constant pressure and constant temperature is passed through an absorber filled with activated carbon; after the breakthrough of krypton, the activated carbon is pumped out to a pressure between 1 and 100 torr, the gas fraction added to the waste gas, the absorber washed at 30-760 torr with an inactive carrier gas (e.g. helium, nitrogen, air) and this fraction separated off for processing. The regenerated absorber is used again. Of advantage are the two parallel-connected absorbers in the system. Further advantageous details of the method are described.

42344 Studies of the retention of aerosols in the Karlsruhe reprocessing plant (WAK). Beaujean, H.; Boelmer, V.; Hermann, G.; Wichmann, H.P. pp 355-364 of Proceedings. Seminar on high efficiency aerosol filtration in the nuclear industry. Aix-en-Provence, 22-25 November 1976. Luxembourg; Commission of the European Communities (Feb 1977). (In German)

From Seminar on high efficiency aerosol filtration in the nuclear industry; Aix-en-Provence, France (23 Nov 1976).

See CONF-761145—.

The wet processing of irradiated nuclear fuels gives rise not only to volatile fission products, which are mainly released during dissolution, but also, in all stages of the process, to liquid aerosols. The aerosols formed contain the fission products or compounds thereof which are soluble in the solvents used. Such aerosols, especially those emitted from the primary containment (the vessels and piping system) may be deposited and resuspended as solids. For the retention of such aerosols high-efficiency particulate filters are used in the reprocessing plant. The vessel ventilation system imposes very exacting demands on these filters, since various processes in the apparatus may give rise to high concentrations in un-filtered air. Operation of the Karlsruhe plant to data has shown that aerosol retention has been satisfactory in relation to permissible discharge levels. Other problems encountered and experience gained in the plant operation as regards the formation and retention of aerosols are dealt with.

42345 Applicability of electrostatic precipitators in reprocessing plants and their limits. Beaujean, H. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)); Laser, M.; Barnert-Wiener, H.; Vygen, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). pp 609-621 of Proceedings. Seminar on high efficiency aerosol filtration in the nuclear industry. Aix-en-Provence, 22-25 November 1976. Luxembourg; Commission of the European Communities (Feb 1977). (In German)

From Seminar on high efficiency aerosol filtration in the nuclear industry; Aix-en-Provence, France (23 Nov 1976).

See CONF-761145—.

Electrostatic precipitators are well proven in current technology for the separation of aerosols. In the field of nuclear technology, however, contradictory results have been found. The main obstacle for an application in radioactive contaminated gas streams is the beta-activity, which ionizes the gas. The positive ions produced recombine with the negatively charged aerosols and therefore prevent the deposition of the aerosols. This effect increases with increased beta activity and increased discharge tube diameter. Good results have been achieved with the separation of cesium aerosols from the burner off-gas in reprocessing of HTR fuel elements, where decontamination factors up to 10^4 were found. The inner diameter of the tube was 45 mm and the activity of the off-gas was below 1 Ci/m^3. The applicability of electrostatic precipitators in the separation of liquid and solid aerosol from the off-gas of a fission product solidification plant is presently being tested. Initial experiments are very promising.

42346 Research and development topics in gas cleaning for fuel reprocessing plant. Elliot, M.N.; Horsley, D.M.C.; Powell, R.M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 509-518 of Proceedings. Seminar on high efficiency aerosol filtration in the nuclear industry. Aix-en-Provence, 22-25 November 1976. Luxembourg; Commission of the European Communities (Feb 1977).

From Seminar on high efficiency aerosol filtration in the nuclear industry; Aix-en-Provence, France (23 Nov 1976).

See CONF-761145—.

Air cleaning in fuel reprocessing plants is based at present essentially upon HEPA filtration. This has proved satisfactory to date but as the industry expands methods with easier handling and storage options will be required. The paper reviews alternative approaches and identifies areas of promising medium and long term development.

42347 Some experience in HEPA filtration at DERE and AWRE. Lillyman, E. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment); Bristow, H.A.S. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). pp 483-494 of Proceedings. Seminar on high efficiency aerosol filtration in the nuclear industry. Aix-en-Provence, 22-25 November 1976. Luxembourg; Commission of the European Communities (Feb 1977).

From Seminar on high efficiency aerosol filtration in the nuclear industry; Aix-en-Provence, France (23 Nov 1976).

See CONF-761145—.

The Dounreay experimental reactor establishment has now been in operation for 20 years, mainly concerned with operation of an experimental fast reactor and the supporting fuel cycles. In this period highly enriched uranium metal fuel elements have been fabricated, irradiated, examined at very short cooling times and reprocessed. In this period, tens of millions of curies of fission products have been handled, together with tens of tonnes of highly enriched uranium in a variety of physical forms, gaseous, liquid, powder and solid metal. These operations have necessitated HEPA filtration protection of the active gaseous effluents emanating from a wide variety of wet and dry chemical and metallurgical processes. This has resulted in some very difficult demands on HEPA filter efficiency. The site is at present changing over to a plutonium fast reactor fuel cycle, which will greatly increase the throughput of fission products. The alpha activity associated with the fuel will rise by 3 orders magnitude. Thus the HEPA filter requirements will be more stringent and at the same time used HEPA filter disposal become a much greater problem. A complete re-appraisal has been made and major changes are necessary on filter housings, changing techniques, disposal methods and ventilation philosophy and design. These changes are being implemented at the moment.

42348 New types of filter for aerosol removal from reprocessing plant off-gases. Strauss, H.J.; Winter, K. pp 401-410 of Proceedings. Seminar on high efficiency aerosol filtration in the nuclear industry. Aix-en-Provence, 22-25 November 1976. Luxembourg; Commission of the European Communities (Feb 1977). (In German)

From Seminar on high efficiency aerosol filtration in the nuclear industry; Aix-en-Provence, France (23 Nov 1976).

See CONF-761145—.

In addition to the basic requirement of the highest possible efficiency, which according to EUROVENT 4/4 'determination by flame spectrometry of the degree of penetration of aerosols filters by a sodium chloride aerosol' (a test based on BS 3928 'Sodium Flame Test') should be greater than 99.999%, aerosol filters used in reprocessing plants should also satisfy other requirements. They should have high chemical resistance to nitric acid and to the nitric oxides which form in dissolvers; even when wet they should be highly resistant to pressure (including shock waves) and, in addition, have adequate dust storage capacity. They should be manufactured in all required configurations and it should be possible to compress them for final storage. Conventional folded filters of glass fibre paper do not meet all these requirements. A recent innovation based on the use of moulded glass fibre casings has made it possible to avoid the drawbacks of conventional filters. The materials used provide chemical resistance, while their inherent stability ensures that the filters react satisfactorily to pressure. Finally, filters of this kind may be manufactured in virtually all configurations.

42349 (ORNL-tr—4629) **Volatilization of low temperature borosilicate glasses for high-level radioactive wastes at elevated temperatures.** Terai, R.; Kosaka, E. Translated by T.E. Ohtani from *Osaka Kogyo Gijutsu Shikenjo Kiho;* **27**: No. 3, 150-156(1976). 28p. Dep. NTIS, PC A03/MF A01.

Vaporization of low temperature borosilicate glasses suitable for storage of high-level radioactive wastes was investigated thermogravimetrically over the temperature range from 1300 to 900°C. Vaporization processes of many glasses used were apparently zero-order reaction at any temperature, suggesting that the controlling-step was the simple escape of volatile components from surface of the melts. It was determined by the chemical analysis that preferential volatile constituents were alkali-borates, such as $Na_2O \cdot B_2O_3$ for Na_2O containing glasses, $2K_2O \cdot B_2O_3$ for K_2O containing glasses at a lower temperature and $K_2O \cdot B_2O_3$ at higher temperatures. Apparent activation energy calculated from Arrhenius-type plotting of evaporation rate was about 50 to approximately 60 kcal/mole, being similar to the evaporation heat of alkali-borates. However, vaporization of some glasses gave parabolic curves at high temperatures, which were attributed to the overlap of both processes of evaporation from surface of the melts and diffusion of volatile components within the melts. From viewpoint of safety evaluation it must be noted that low temperature borosilicate glasses have a large evaporation rate at high temperature, that the vapor exerts a severe corrosivity upon the apparatus materials, and that the evaporation

rate of borosilicate glasses was considerably enhanced by the water vapor in atmosphere. Safety temperature at which the escape of volatile components should be depressed up to the order of 10^{-6} [g/cm^2 . day] was estimated at about 600 to approximately 700°C for these glasses.

42350 Method for solidification and disposal of radioactive pellet waste. Yasumura, K.; Matsuura, H. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-73,300/A/. 15 Dec 1975. 2p. (In Japanese).

A method is goven to form radioactive waste into pellet, which is impregnated with plastic monomer for polymerization, and then packed into a drum can to have gaps between composites filled with cement, mortar, and molten asphalt, thus increasing water resistance and strength. Radioactive powdery bodies discharged from a thin film scaraping drier are formed into pellets in the desired shape. The thus pelletized radioactive solid waste is impregnated with a fluid plastic monomer such as styrene monomer and i.e., a methyl methacrylate, and a polymerization accelerator is added for polymerization. As a consequence, a composite pellet of powdery solid waste and plastic may be obtained. This is packed into the drum can container, into which cement paste, cement mortar or molten asphalt are put to fill the space between the plastic pellet composites, thus obtaining a solidified body integral with the drum can.

42351 Method of tentatively disposing radioactive solid waste. Otaka, H.; Taniguchi, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-72099/A/. 10 Dec 1975. 2p. (In Japanese).

A method is given to minimize a secondary waste and to prevent scattering and leakage of radioactive waste outside. An asphalt pouring auxiliary frame is put into a drum can, and asphalt is poured and solidified between the drum can and the auxiliary frame, and thereafter the auxiliary frame is removed. Next, solid material (powdery condensed waste, filtered sludge after dewatered, already used resin, and already used powdery resin) is poured through a sludge hopper, and asphalt is poured into a space formed at the upper part of the drum can, after which a cover is fastened and a lead shield is applied to the drum can.

42352 Method for disposal of liquid waste in an atomic power plant. Shoji, S.; Tanno, K.; Kikuchi, E. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-72,098/A/. 10 Dec 1975. 3p. (In Japanese).

A method is described to reduce a corrosive property of liquid waste, after which enrichment, reduction in volume and solidification are accomplished in a state where principal dissolved components are recovered. Regenerated liquid waste from machineries, floor drain and condensation and dechlorination apparatus are collected into a reducing tank, after which the reducing agent is added to reduce chromate ion, which facilitates a corrosive property of liquid waste, into chromic ion. Next, in a deposition forming tank, pH is adjusted into weak alkali, which is filtered to remove deposition of chromium hydroxide. Sodium sulfate much contained in filtrate is recovered as concentrated sodium hydroxide and solution sulfate by an ion exchange film electrolytic dialysis tank for re-use in regeneration of ion exchange resin. Rare liquid waste from the electrolytic dialysis tank is vaporized and condensed by a condenser, and the remaining condensed liquid is stored in a sealed storage container.

42353 Method of processing wastes. Seki, S.; Ouchi, K.; Hisa, I.; Emura, S. (to Japan Atomic Energy Research Inst., Tokyo). Japanese Patent 1977-41,800/A/. 30 Sep 1975. 3p. (In Japanese).

To reduce leakage, radioactive wastes are mixed with cement and water and put into a drum container coated with an asphalt layer and are left there until the system is solidified. Then, external pressure is applied to the solidified cement body in the drum container to thereby closely cover the solidified cement body with the asphalt layer.

42354 Treatment method of radioactive waste oil. Kawasaki, K.; Takeda, S. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 977-28,000/A/. 27 Aug 1975. 4p. (In Japanese).

A method is described to efficiently separate radioactive solid matter from radioactive waste oil containing minute radioactive solid particles (UF_4) produced as a result of reaction between oil and UF_6 and concentrate the separated solid matter. A petroleum hydrocarbon solvent (such as hexane, petroleum ether, xylene, benzene, etc.) which does not react with the radioactive solid matter is added to the waste oil, and the mixture is agitated at a high speed to reduce the viscosity of the oil. Then, the mixture oil is forcibly filtered by using a vacuum pump or the like to thereby separate the radioactive solid matter. The non-radioactive oil and solvent contained in the filtrate are separated by making use of the difference in the vapor pressure.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 42328, 42339, 42341, 42389, 43337, 43607, 43758

42355 (DOE/ER—0004/D) Report of Task Force for review of nuclear waste management. Draft. (Department of Energy, Washington, D.C. (USA). Office of Energy Research). Feb 1978. 176p. Dep. NTIS, PC A09/MF A01.

Some of the findings of the Task Force are: a majority of independent technical experts have concluded that high-level waste can be safely disposed in geological media, but validation of the specific technical choices will be an important element of the licensing process. Reprocessing is not required for the safe disposal of commercial spent fuel. Consideration should be given to an early demonstration of the geologic disposal of a limited number of spent fuel assemblies in the waste Isolation Pilot Plant. The Spent Fuel Policy announced by President Carter in October 1977 must be integrated with the Waste Management Policy. The Task Force report highlights the importance of away from reactor storage that occurs between on-site storage of spent fuel at utilities and ultimate disposal. The target for initial operation in 1985 os a National Waste Repository for the permanent disposal of commercial high-level waste as spent fuel may not be met; this does not affect the early 1980s schedule for the Waste Isolation Pilot Plant. The responsibility for the ultimate disposal for all forms of nuclear waste should be with the Federal Government and long-term waste disposal facilities should be subject to NRC licensing. The NEPA process is an essential part of the nuclear waste management program and Department of Energy efforts in this regard must be strengthened. Policy and program management responsibility for Waste Management should be raised to a higher level in the Department of Energy. There are substantial budgetary impacts of the Task Force recommendations and legislation would be required to carry out many of the suggested changes. (LK)

42356 (KBS-TR—05) Introductory calculations of temperatures in a rock storage for final disposal of radioactive waste. Blomqvist, R. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Mar 1977. 69p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

This report gives details concering pre-requisies, assumptions and results for some introductory temperature calculations regarding final disposal of radioactive waste in hard rock. The calculations, which illustrate the influence of dimensional parameters, age of the waste etc, include waste from reprocessed nuclear fuel and non-reprocessed spent fuel. The calculations mainly deals with a repository geometry, where the waste containers are placed in vertical holes and surrounded by a layer of quartz sand mixed with bentonite. For non-reprocessed fuel calculations have also been performed for an alternative geometry. In this case, the waste containers are placed directly in horizontal tunnels filled with a quartz sand - bentonite mixture.

42357 (KBS-TR—06) Groundwater movements around a repository. Phase 1, State of the art and detailed study plan. Lindblom, U. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Feb 1977. 113p. Dep. NTIS (US Sales Only), PC A06/MF A01.

The report was prepared as the first phase of a study of the groundwater movements around a repository for spent nuclear fuel in the precambrian bedrock of Sweden. The objectives of these studies are to provide a state-of-the-art review of groundwater flow in the region of a repository in granitic rock, in order to provide a basis for long term containment assessments and to prepare a detailed study plan for the continuation of the project. The different processes affecting the groundwater situation for containment are given. A state of the art review of the fluid flow, geochemical, heat transfer and rock mechanics processes as they relate to containment is presented. A detailed study plan to provide a comprehensive assessment of the hydrogeological regime around the repository during its lifetime is also presented. The groundwater flow fields will provide a basis for subsequent long term containment studies.

42358 (KBS-TR—07) Studies of decay power for KBS part 1. Literature review part 2. Calculations. Ekberg, K.; Kjellbert, N.; Olsson, G. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Apr 1977. 56p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The decay power of irradiated PWR and BWR fuel has been calculated in the decay range of 1-10000 years using the Studvik computer code BEGAFIP and the ORNL code ORIGEN. Vitrified waste from reprocessed fuel - with 99.5 percentU and Pu eliminated - has been followed to 1000 years. The two programmes show reasonable agreement for fission products, but ORIGEN is some 30 percent lower for actinides. Recommended values, based also on complementary results from the depletion code CASMO, are given for unprocessed fuel and for vitrified waste, assuming reprocessing either 2 or 10 years after discharge. The recommended values are

conservatively chosen and are based on ORIGEN fission product results and BEGAFIP actinide results. An error analysis is given.

42359 (KBS-TR—08) **Leaching of French, English and Canadian glass with incorporated highly radioactive waste.** Blomquist, G. (Kaernbraenslesaekerhet, Stockholm (Sweden)). May 1977. 27p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A survey has been made of typical leach rates for French and English glasses used for incorporating highly radioactive waste. For French glass, calculations have been made to find the time- and temperature tendencies of the leach rates of Cs and Sr in range 25 - 110°C using published values for the diffusion coefficients up to 70°. For the higher temperature range, the diffusion coefficients have been calculated. According to the calculations, leach rates of French LWR glasses are significantly less temperature dependent than English glass for Magnox waste. Canadian nepheline-syenite glasses have leach rates several orders of magnitude lower than other glasses.

42360 (KBS-TR—09) **Diffusion of soluble materials in a fluid filling a porous medium.** Haeggblom, H. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Mar 1977. 28p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The physical and mathematical foundations of diffusion in porous media are explained. Equations for diffusion of a radioactive nuclide chain are derived. The program DIWA for computing one-dimensional diffusion of one nuclide is described and results from such calculations are given. An underground deposition of wastes was assumed at a depth of 500 m. For a pessimistic assumption about the diffusion coefficient, no decay and no adsorption, the discharge at the ground level was negligible for at least 70000 years.

42361 (KBS-TR—10) **Translation and development of the BNWL-geosphere model.** Grundfelt, B. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Feb 1977. 30p. Dep. NTIS (US Sales Only), PC A003/MF A01.

The report deals with the rate of radioactivity discharge from a repository for radioactive waste in a geologic formation to the biosphere. A BASIC language computer program called GETOUT has been developed in USA. It was obtained by the Swedish project Nuclear Fuel Safety and has thereafter been translated into FORTRAN. The main extension of the code, that was made during the translation, is a model for averaging the hydrodynamic and geochemical parameters for the case of non-uniform packing of the column (e.g. considering a repository in cracked rock with crack width, crack spacing etc. in different zones). The program has been outtested on an IBM model 360/75 computer. The migration is governed by three parameters i.e. the ground water velocity, the dispersion coefficient and the nuclide retentivities.

42362 (KBS-TR—11) **Suitability of titanium as a corrosion resistant canister for nuclear waste.** Henriksson, S.; Pettersson, K. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Aug 1977. 55p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

A literature study and inventory of experience has been carried out, aimed at assessing the possibilities of unalloyed and Pd-alloyed titanium withstanding corrosion for 1000 - 10000 years in contact with Baltic Sea water at 100°C and pH 4 - 10. The following assesment can be made: (1) Pitting, crevice corrosion, stress corrosion cracking and corrosion fatigue constitute no problem if the canister is made of unalloyed titanium corresponding to ASTM Grade 1. (2) Linear extrapolation of reported corrosion rates for oxidation and general corrosion gives a life of between 1000 and 10000 years for a 5 mm thick canister. (3) Hydrogen embrittlement resulting from hydrogen pick-up from the deposition environment should not occur. Delayed failure caused by a redistribution of the hydrogen initially present in the titanium can be avoided if its concentration is maximized to 20 ppm.

42363 (KBS-TR—13) **Leaching from irradiated nuclear fuel by direct disposal.** Gelin, R. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Jun 1977. 18p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

To evaluate the radiological hazards of storing irradiated fuel in geological formations the literature of leaching irradiated LWR fuel in water has been studied. There seems to have been made very few relevant experimental studies. Leach tests are being performed at Batelle-Northwest, Richland, US and some of the results have been published. These results and conclusions are summarized and discussed. The relative leachability of the elements decrease in the order of Cs > Sb > Sr + Y > Pu > Cm. The cesium based periodic leach rate for irradiated fuel fragments are similar to the based leach rate for borosilicate glass containing radioactive waste.

42364 (KBS-TR—15) **Introductory calculations of temperatures in a rock storage for final disposal of radioactive waste. Report No. 2.** Blomquist, R. (Kaernbraenslesaekerhet, Stockholm (Sweden)). May 1977. 38p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The first part of this report deals with an extension of earlier parametric studies regarding disposal of highly radioactive glass in vertical holes deeply in hard rock. The extension mainly deals with how the temperature of the waste is influenced by the active length of the holes, the diameter of the waste containers and the concentration of fission products in the glass. Besides is also shown some results of calculations regarding an actual storage geometry in 4 levels. The report also presents a parametric study of a final storage containing non-reprocessed spent fuel. In this case the waste containers are assumed to be placed horizontally in tunnels filled with a mixutre of clay and sand.

42365 (KBS-TR—16) **Survey of foreign risk analyses with plans and projects concerning final disposal.** Hultgren, Aa. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Aug 1977. 43p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Risk analysis of the back end of the fuel cycle is now being given increasing efforts in several nuclear power countries. A review of the major programs abroad in this field, especially for terminal storage of high level nuclear waste, is given in the first part of this report. The second part of the report reviews major projects and plans for terminal storage in America and in Western Europe, with a brief reference to cooperation in international fora. The most comprehensive program is in progress in the United States. For Sweden it seems that also the programs in Canada and France are of particular interest due to their concentration on terminal storage in crystalline rocks.

42366 (KBS-TR—22) **Influence of rock movement on the stress/strain situation in tunnels or bore holes with radioactive canisters embedded in a bentonite/quartz buffer mass.** Pusch, R. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Aug 1977. 25p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The report presents the author's main ideas concerning the possible recurrence of large unexpected movements in Swedish pre-Cambrian rock and gives the theoretical basis for the calculation of stress and strain in the canisters and the buffer mass. A rough calculation shows that a sudden and large shear strain at actual depths will only occur along already existing continous weak zones in the bedrock. In situ rock investigations to find and locate weak zones are essential. Shear tests with a model shear apparatus were run with the canister embedded in 10 percent bentonite 90 percent quartz buffer mass. The least favorable theory (Meyerhof) gave high contact pressures which cause high bending momentum on the canister. The stresses can be reduced by changing the geometry of the canister.

42367 (KBS-TR—24) **Calculated leaching of certain fission products from a cylinder of French glass.** Blomqvist, G. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Jul 1977. 51p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The probable total leaching of the most important fission products and actinides have been tabulated for a cylinder of French HLW glass with approximately 9 percent fission products. The calculations cover the period between 30 and 10000 years after removal from the reactor. The cylinder is of the type planned for the introduction of the HLW into Swedish crystalline rocks. All the components are supposed to have the same leach rate. The calculations also include the probable thickness of eroded glass layer/year.

42368 (KBS-TR—26) **Estimation of the possibility for delayed failure in Titanium.** Pettersson, K. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Aug 1977. 25p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The possibility of delayed failure in a titanium canister for radioactive waste has been analyzed. This analysis is based on a Canadian theory for delayed failure of zirconium alloys. Calculations carried out for different hydrogen contents of the material show, that in order to exclude the possibility of delayed failure, the hydrogen content should be kept below 20 ppm. This means that the hydrogen content is permanently below the solubility limit.

42369 (KBS-TR—31) **Estimation of the corrosion resistance of materials intended for enclosure of nuclear fuel waste. State of the art report 1977-09-27 and supplementary remarks.** (Kaernbraenslesaekerhet, Stockholm (Sweden)). Sep 1977. 154p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

Within the KBS project the Swedish Corrosion Institute has got the task to evaluate the corrosion resistance of different materials proposed to be used in canisters for nuclear waste. For this purpose the Institute appointed a reference group of specialists, mainly within the fields of corrosion and materisl. KBS has proposed three different alternatives of canisters: 1. Titanium lined with lead as a canister material for reprocessed and vitrified waste. 2. Copper as a canister material for direct disposal of spent fuel. 3. Alumina as a canister material for direct disposal of spent fuel. For further evaluations the Institute points out the need of complementary investigations, e.g. on

variations in ground water composition at a depth of 500 m, especially the content of oxygen, chloride, nitrite, sulfate and organic matter.

42370 (NTIS/PS—77/1085) **Radioactive waste disposal in salt deposits (a bibliography with abstracts). Report for 1964-Dec 77.** Cavagnaro, D.M. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 96p. NTIS PC N01/MF N01.

This bibliography contains reports on underground disposal of radioactive wastes in salt deposits. The citations cover radiation protection, efficiency of the disposal method, sites that are selected, stability of the sites, mathematical models of the disposal method, hydrology, and design. (Contains 91 abstracts)

42371 (ORNL/SUB—3696/1) **Analysis of solutioning of salt around well boreholes.** Dixon, T.N. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). 1 Oct 1973. Contract W-7405-ENG-26. 34p. Dep. NTIS, MF A01.

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Experimental and analytical work on the problem of salt dissolutioning through wellbores is described. The project involved three phases. The first, relating to the dissolution of salt by an underlying aquifer, studied the stability and rate of salt convection down a vertical capillary tube. The second phase, relating to the dissolutioning process by discharge from an overlying aquifer to an underlying aquifer, was the use of a mathematical model developed for salt mining and LPG storage cavern development for prediction of cavity shapes during washing operations to the long-time prediction of cavity shapes and volumes. The third phase was the development of two-dimensional numerical models for the simulation of the before-mentioned processes. It was found that the rate of convection quickly decreases as the salt concentration builds up in the bottom of the wellbore; the rate of transport over a long period of time would depend upon the rate at which the salt was removed from the bottom of the wellbore, as well as its rate of convection down the wellbore. The most likely maximum rate should be no more than about 10% of the 1 foot diameter open hole maximum rate. The effective radius of the cavity for this case would be 280 feet. The shapes of the cavity under dissolutioning by fresh water from overlying aquifers show that the model predicted an extreme "morning glory" effect. It was concluded that this model was probably not accurate for long periods after the fluid in the cavity had become saturated. A two-dimensional numerical model of the convection-diffusion process in the wellbore was developed. The model was used to simulate the convection process using a diameter of .1 cm and lengths of 1, 5 and 10 cm. The flow was stable. When the diameter was increased to 2 cm. the numerical solution was unstable except for very small time step sizes. It is felt that this numerical instability can be overcome by revising the algorithm used.

42372 (PNL—2247) **Devitrification behavior in a zinc borosilicate nuclear waste glass.** Turcotte, R.P.; Wald, J.W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-06-1830. 43p. Dep. NTIS, PC A03/MF A01.

Experimental studies of thermally induced changes in a simulated nuclear waste glass were conducted to define the composition and concentration of all phases formed over a broad range of time (up to one year) and temperature ($<1200°C$) conditions. Depending on time and temperature, a steady-state condition is achieved in which a number of crystalline phases coexist with a glass phase which is partially depleted of some elements. Concentrations of the phases increase with decreasing temperature but usually reach only a fraction of their maximum theoretical concentration. Considering the major phase formed (Zn_2SiO_4), this fractional concentration is about 10% at 900°C and 45% at 700°C, when equilibrium is achieved. Under these unfavorable time/temperature conditions, the glass is about one-third crystalline. Because of melt insolubles (RuO_2,Pd) the most homogeneous glass will contain approximately 3% crystalline phases. Crystallization occurs at rates in agreement with those estimated from theory, based on a knowledge of the glass viscosity and an estimated heat of crystallization for the Zn_2SiO_4 phase. The times to reach steady-state concentrations range from a few hours at 900°C to approximately 1 year at 700°C. No crystallization at 500°C was observed after one year. The crystal ingrowth rates follow a reasonable 1/T dependence for Zn_2SiO_4 and give an activation energy for the process of approximately 40 kcal/mole. Growth rates for the other phases are of the same order of magnitude as for Zn_2SiO_4. Results of the present work are used to evaluate processing/storage conditions needed to maintain a vitreous product. It is shown that crystallization over very long time periods (10^6 years) will likely occur only if ambient temperatures exceed approximately 225°C for the entire time period.

42373 (RHO-ST—16) **Status report: radioactive waste packaging study.** Calmus, D.B. (Atomics International Div., Richland, Wash. (USA). Rockwell Hanford Operations). Dec 1977. Contract EY-77-C-06-1030. 74p. Dep. NTIS, PC A04/MF A01.

Current practices and proposed concepts of radioactive TRU waste handling and storage systems have been reviewed and analyzed for the purpose of establishing preliminary waste package acceptance criteria. A set of criteria for low-level TRU waste (LLTW), intermediate-level TRU waste (ILTW), and cladding waste have been developed and are presented here for the purpose of soliciting comments. In the course of writing this document and developing the criteria, a number of areas have been identified as requiring additional study to support the criteria. These studies will be conducted prior to finalizing criteria.

42374 (SAND—78-0937C) **Seabed high level waste assessment program. Statement before the House of Representatives Committee on Merchant Marine and Fisheries, Subcommittee on Oceanography, May 16, 1978.** Anderson, D.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 24p. Dep. NTIS, PC A02/MF A01.

Sandia Laboratories were charged with the tasks of assessing the environmental and technical feasibility of isolating high-level waste beneath the deep ocean floor in geologically stable and biologically inactive regions, and of developing a capability to assess other ocean disposal programs. This presentation summarizes the progress and task status of the Seabed Program. Objectives and milestones of the program are outlined. Areas which might be suitable for use as disposal sites were identified. The disposal question is being treated as a multiple barrier assessment problem. The normal slow diffusion of waste elements through the deep-sea clay is reduced more than a thousandfold by its sorptive properties. Emplacement concepts being considered are the penetrometer, weighted probe, trencher, and drilled holes. Advantages and disadvantages of the seabed option are listed. The international programs underway on this disposal option are mentioned. (DLC)

42375 (UCRL—13842-1) **New numerical method for solving the solute transport equation.** Ross, B.; Koplik, C.M. (Analytic Sciences Corp., Reading, Mass. (USA)). 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The solute transport equation can be solved numerically by approximating the water flow field by a network of stream tubes and using a Green's function solution within each stream tube. Compared to previous methods, this approach permits greater computational efficiency and easier representation of small discontinuities, and the results are easier to interpret physically. The method has been used to study hypothetical sites for disposal of high-level radioactive waste.

42376 (Y/OWI/SUB—77/16534) **Project control support services for the National Waste Terminal Storage Program.** (Boeing Engineering and Construction, Seattle, Wash. (USA)). Dec 1977. Contract W-7405-ENG-26. 133p. Dep. NTIS, PC A07/MF A01.

The Boeing Engineering and Construction Company has the responsibility to recommend and assist in designing and implementing a project control system for the Office of Waste Isolation. BEC, after analysis of the OWI management structure and techniques utilized, has recommended the implementation of a Program Control System (PCS) for use by OWI. This system embraces the scope of management needs for visibility and control of cost and schedule performance as well as providing a framework for all the various segments of a complete program control system. Because of the schedule constraints placed on OWI by DOE it was not deemed practical to implement all segments of PCS but rather those that are basic to the concept and can return the greatest short-term benefit. The area of cost and schedule control appears to provide the greatest benefit when combined with the control room techniques for visibility and control. Technical performance is not covered in this report. The segment of PCS titled Integrated Cost/Schedule (IC/S) was used to identify those functions unique to cost and schedule control.

42377 (Y/OWI/SUB—77/45707) **Postdecommissioning monitoring feasibility study for radioactive waste repositories in rock salt formations.** (Ebasco Services, Inc., New York (USA)). Sep 1977. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

A preliminary evaluation of the postdecommissioning monitoring of a radioactive waste repository facility established in bedded or domal salts has been performed. The results of the study indicate that while some general conclusions as to monitoring feasibility can be made, any detailed evaluation of monitoring program effectiveness must be based upon evaluations performed for a specific site. A wide range of presently available instrument packages could be deployed in surface, borehole, or buried locations to monitor key radiological, geological, and hydrological properties of the repository and its surroundings after decommissioning. If sufficient sensitivity can be obtained, these measurements, when correlated with analytical modeling results, could provide a description of repository integrity, allowing further extrapolations of expected behavior. Definitive projections of sensitivity and thus the applicability of presently available instrumentation cannot be made, however, without reference to specific site characteristics or without the benefit of regulatory criteria. Owing to reliability considerations and techno-

logical limitations, it appears that any monitoring program should be based upon sensors located either at the surface or in accessible boreholes or subsurface galleries which do not penetrate the repository containment strata. Because of this feature of retrievability of the sensing devices such a system could be maintained for an indefinite period of time. It is recommended that plans for postdecommissioning monitoring be given further consideration during the specification of site investigation and preoperation programs. Particular effort should be expended in (1) developing regulatory criteria appropriate to the decommissioned repository, (2) defining what constitutes a significant variation in monitorable parameters, and (3) comparing these variations and regulatory criteria with instrument sensitivities under actual site conditions.

42378 (Y/OWI/SUB—4082/3) **Numerical simulation of salt transport in vertical boreholes.** Santos, R.; Knapp, R.M. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). Dec 1976. Contract W-7405-ENG-26. 152p. Dep. NTIS, MF A01.

Portions of document are illegible.

A finite difference study is made of the problem of salt transport in vertical boreholes. A rectangular cavity initially filled with fresh water is chosen to represent the vertical wellbores. The top of the rectangle is always supplied with saturated salt water and the bottom with fresh water. The problem is formulated in terms of three simultaneous nonlinear partial differential equations: salt concentration, vorticity and stream function. The Alternating Direction Implicit method (ADI) is chosen to solve the concentration and vorticity formulations. The method of Successive Over Relaxation (SOR) is used to solve the stream function relation. The instability problems associated with high Grashof numbers are overcome by using the second upwind differencing technique. Three dimensionless flow parameters are considered in the finite difference solutions: (1) the ratio of gravity to viscous forces referred to as Grashof number, Gr; (2) the ratio of viscous to diffusion forces known as Schmidt number, Sc; and, the cavity length to width ratio, L. A Nusselt number correlation is derived from the numerical method. This correlation is found to be dependent on the length to width ratio of the cavity, L, only. A steady state rate of salt transport is computed from the Nusselt number for various rectangular cavities. 15 tables, 32 figures.

42379 (Y/OWI/TM—43/5) **Office of Waste Isolation progress report, February 1978.** Rhines, R.C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 28 Mar 1978. Contract W-7405-ENG-26. 64p. Dep. NTIS, PC A04/MF A01.

Progress on the National Waste Terminal Storage (NWTS) program is reported in the form of project reports on work performed by commercial and/or nonprofit organizations, DOE contractors, OWI consultants, and other federal agencies participating in the NWTS program. They are grouped under the headings technical projects, facility projects, planning and analysis, and regulatory affairs. (DLC)

42380 (Y/OWI/TM—43/7) **Office of Waste Isolation progress report, April 1978.** Rhines, R.C. (ed.). (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 24 May 1978. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

This document reports progress on the OWI's portion of the National Waste Terminal Storage program. The progress is reported under the following headings: technical projects, facility projects, planning and analysis, and regulatory affairs. (DLC)

42381 (Y/OWI/TM—48) **Screening specifications for Gulf Coast salt domes.** Brunton, G.D.; Laughon, R.B.; McClain, W.C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 21 Feb 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

A reconnaissance survey of the salt domes of Mississippi, Louisiana, and east Texas is being planned to identify study areas for potential sites for radioactive waste disposal. Preliminary screening specifications were derived for each of the geological evaluation criteria by application of the significant factors that will have an impact on the reconnaissance survey. The procedure for the derivation of each screening specification is discussed. The screening specifications are the official OWI values to be used for the first-cut acceptance for salt dome study areas along the Gulf Coast. The derivation of the screening specifications is illustrated by (1) a statement of the geological evaluation criterion, (2) a discussion of the pertinent factors affecting the criterion, and (3) the evaluation of the value of the specification. (DLC)

42382 (Y/OWI/TM—54) **Screening specifications for bedded salt, Salina Basin, New York and Ohio.** Brunton, G.D.; Laughon, R.B.; McClain, W.C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 14 Mar 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

A survey of bedded salt deposits in New York and Ohio is planned to identify study areas for potential sites for radioactive waste disposal. Prior to the survey previous geological work related to these deposits will be reviewed. Preliminary screening specifications for the identification of study areas were derived for each of the geological evaluation criteria by application of the significant factors that will have an impact on the reconnaissance survey. These factors were selected by a review of the list of factors associated with each criterion. The procedure for the derivation of each screening specification is discussed. The screening specifications are the official Office of Waste Isolation values to be used for the first-cut acceptance for bedded salt study areas in Ohio and New York. The specifications will be reevaluated and refined for more-detailed investigations at each study area that passes the screening test. The derivation of the screening specifications is illustrated by (1) a statement of the geological evaluation criterion, (2) a discussion of the pertinent factors affecting the criterion, and (3) the evaluation of the value of the specification.

42383 **Disposal of high-level radioactive waste.** Glasby, G.P. (Department of Scientific and Industrial Research, Wellington (New Zealand). Oceanographic Inst.). *N.Z. Energy J.*; **50**: No. 7, 100-104(25 Jul 1977).

Although controversy surrounding the possible introduction of nuclear power into New Zealand has raised many points including radiation hazards, reactor safety, capital costs, sources of uranium and earthquake risks on the one hand versus energy conservation and alternative sources of energy on the other, one problem remains paramount and is of global significance - the storage and dumping of the high-level radioactive wastes of the reactor core. The generation of abundant supplies of energy now in return for the storage of these long-lived highly radioactive wastes has been dubbed the so-called Faustian bargain. This article discusses the growth of the nuclear industry and its implications to high-level waste disposal particularly in the deep-sea bed.

42384 **Researching radioactive waste disposal.** Feates, F.; Keen, N. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). *New Sci.*; 77: No. 1090, 426-428(16 Feb 1976).

At present it is planned to use the vitrification process to convert highly radioactive liquid wastes, arising from nuclear power programme, into glass which will be contained in steel cylinders for storage. The UKAEA in collaboration with other European countries is currently assessing the relative suitability of various natural geological structures as final repositories for the vitrified material. The Institute of Geological Sciences has been commissioned to specify the geological criteria that should be met by a rock structure if it is to be used for the construction of a repository though at this stage disposal sites are not being sought. The current research programme aims to obtain basic geological data about the structure of the rocks well below the surface and is expected to continue for at least three years. The results in all the European countries will then be considered so that the United Kingdom can choose a preferred method for isolating their wastes. It is only at that stage that a firm commitment may be made to select a site for a potential repository, when a far more detailed scientific research study will be instituted. Heat transfer problems and chemical effects which may occur within and around repositories are being investigated and a conceptual design study for an underground repository is being prepared.

42385 **Apparatus for separation of mixture gas.** Ozaki, O.; Yoshimori, M.; Kakuta, A.; Ono, M. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-63,600/A/. 20 Nov 1975. 3p. (In Japanese).

An apparatus is described for separating Kr and Xe gases from waste gases in an atomic power plant wherein flowing-in of O_2, H_2O, and acid from outside the apparatus is made unnecessary in order to prevent corrosion of apparatus and to miniaturize the apparatus. The waste gas is increased in pressure by means of a gas compression pump in a primary gas separator and fed into an absorbing tower in which solvent flows down, where hydrocarbon, NOx, Kr, Xe gases are mainly absorbed. The solvent having absorbed the gases is fed to a desorption tower, and dissolved gases in the solvent are desorbed from the solvent to be flown out of the top of tower and separated from the accompanying solvent by means of a gas and liquid separator and thence fed toward a secondary gas separator. This mixed gas is compressed by a compression pump and fed to a diaphragm type secondary gas separator, and then separated into a light molecule portion such as hydrocarbon, nitrogen oxide or the like, and a heavy molecule portion such as Kr, Xe gases or the like.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42183, 42332, 42357, 42361, 43096, 43559, 43612

42386 (IAEA-AG—63-24) **Environmental aspects of fast reactor fuel reprocessing.** Gedeonov, L.I.; Lazarev, L.N.; Suprunenko, A.N. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 13p. (In Russian). (CONF-760576—29). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

In this paper the environmental protection from the standpoint of system analysis is considered. A general review of the environmental protection system in the vicinity of sources of radioactivity release is provided. The basic interactions and feed backs are shown, specific characteristics of radioactivity release in fast-breeder and thermal reactors fuel cycles are considered together with measures of environmental protection. The necessity is shown for a study of total regional and global effect of radioactivity release on environment.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 42323, 43581

42387 (PB—275041) **Electronic instrument for radon daughter dosimetry. Report of investigations.** Durkin, J. (Bureau of Mines, Pittsburgh, Pa. (USA). Pittsburgh Mining and Safety Research Center). 1977. 27p. (BM-RI—8255). NTIS PC A03/MF A01.

Due to the daily exposures of uranium mining personnel to 222Rn daughters, a device is needed which will continually monitor the individual's exposure. Such a device has been built and tested and is known as the Radon Daughter Dosimeter. This is an electronic instrument using a solid-state detector and circuitry. The system permits the evaluation of cumulative exposures to airborne radon progeny, expressed in units of Working Level Hours (WL-HRS). The instrument is a personal device worn by the individual throughout the working shift. Since the instrument is in close proximity to the miner and measures continual exposure, it provides an accurate account of total cumulative exposure, thus avoiding the errors caused by the present technique of spot checking of the environment.

REGULATIONS

REFER ALSO TO CITATION(S) 43100

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 43098

42388 (CONF-780330—2) **Fuel cycles using adulterated plutonium.** Brooksbank, R.E.; Bigelow, J.E.; Campbell, D.O.; Kitts, F.G.; Lindauer, R.B. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

From ASME symposium; Albuquerque, NM, USA (16 Mar 1978).

Adjustments in the U-Pu fuel cycle necessitated by decisions made to improve the nonproliferation objectives of the US are examined. The uranium-based fuel cycle, using bred plutonium to provide the fissile enrichment, is the fuel system with the highest degree of commercial development at the present time. However, because purified plutonium can be used in weapons, this fuel cycle is potentially vulnerable to diversion of that plutonium. It does appear that there are technologically sound ways in which the plutonium might be adulterated by admixture with ^{238}U and/or radioisotopes, and maintained in that state throughout the fuel cycle, so that the likelihood of a successful diversion is small. Adulteration of the plutonium in this manner would have relatively little effect on the operations of existing or planned reactors. Studies now in progress should show within a year or two whether the less expensive coprocessing scheme would provide adequate protection (coupled perhaps with elaborate conventional safeguards procedures) or if the more expensive spiked fuel cycle is needed as in the proposed civex pocess. If the latter is the case, it will be further necessary to determine the optimum spiking level, which could vary as much as a factor of a billion. A very basic question hangs on these determinations: What is to be the nature of the recycle fuel fabrication facilities. If the hot, fully remote fuel fabrication is required, then a great deal of further development work will be required to make the full cycle fully commercial.

42389 (ORNL/TM—6163) **Evalution of NDA techniques and instruments for assay of nuclear waste at a waste terminal storage facility.** Blakeman, E.D.; Allen, E.J.; Jenkins, J.D. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 84p. Dep. NTIS, PC A05/MF A01.

The use of Nondestructive Assay (NDA) instrumentation at a nuclear waste terminal storage facility for purposes of Special Nuclear Material (SNM) accountability is evaluated. Background information is given concerning general NDA techniques and the relative advantages and disadvantages of active and passive NDA methods are discussed. The projected characteristics and amounts of nuclear wastes that will be delivered to a waste terminal storage facility are presented. Wastes are divided into four categories: High Level Waste, Cladding Waste, Intermediate Level Waste, and Low Level Waste. Applications of NDA methods to the assay of these waste types is discussed. Several existing active and passive NDA instruments are described and, where applicable, results of assays performed on wastes in large containers (e.g., 55-gal drums) are given. It is concluded that it will be difficult to routinely achieve accuracies better than approximately 10—30% with "simple" NDA devices or 5—20% with more sohpisticated NDA instruments for compacted wastes. It is recommended that NDA instruments not be used for safeguards accountability at a waste storage facility. It is concluded that item accountability methods be implemented. These conclusions and recommendations are detailed in a concurrent report entitled "Recommendations on the Safeguards Requirements Related to the Accountability of Special Nuclear Material at Waste Terminal Storage Facilities" by J.D. Jenkins, E.J. Allen and E.D. Blakeman.

42390 (PNL—2592) **Considerations for sampling nuclear materials for SNM accounting measurements.** Brouns, R.J.; Roberts, F.P.; Upson, U.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 43p. (NUREG/CR—0087). Dep. NTIS, PC A03/MF A01.

This report presents principles and guidelines for sampling nuclear materials to measure chemical and isotopic content of the material. Development of sampling plans and procedures that maintain the random and systematic errors of sampling within acceptable limits for SNM accounting purposes are emphasized.

42391 (SAND—78-0391) **SECOM II communications system.** Olson, W.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

The SECOM II (SEcurity COMmunications) system is a High Frequency (HF) system which provides two-way digital communications between a central controller and vehicles carrying nuclear weapons and special nuclear material anywhere in the contiguous 48 states. The system operates on four HF frequencies in the 3 to 12 Mhz range. While the primary mode of operation is digital, a voice capability is also provided for unusual situations where additional information must be communicated. Initial system operation began in April, 1976 and the system became fully operational in March, 1977. The system consists of mobile terminals installed in vehicles which communicate with five relay stations. The relay stations are connected with the control center by leased telephone lines. The report describes the operation of the system and the equipment installed in the vehicles, relay stations, and the control center.

42392 (UCRL—80464) **Gamma spectrometric methods for measuring plutonium.** Gunnink, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Feb 1978. Contract W-7405-ENG-48. 16p. (CONF-780522—5). Dep. NTIS, PC A02/MF A01.

From ANS topical meeting; Williamsburg, VA, USA (15 May 1978).

Nondestructive analyses of plutonium can be made by detecting and measuring the gamma rays emitted by a sample. Although qualitative and semiquantitative assays can be performed with relative ease, only recently have methods been developed, using computer analysis techniques, that provide quantitative results. This paper reviews some new techniques developed for measuring plutonium. The features of plutonium gamma-ray spectra are reviewed and some of the computer methods used for spectrum analysis are discussed. The discussion includes a description of a powerful computer method of unfolding complex peak multiplets that uses the standard linear least-squares techniques of data analysis. This computer method is based on the generation of response profiles for the isotopes composing a plutonium sample and requires a description of the peak positions, relative intensities, and line shapes. The principles that plutonium isotopic measurements are based on are also developed, followed by illustrations of the measurement procedures as applied to the quantitative analysis of plutonium liquid and solid samples.

42393 **Publication concerning the scope of application of the treaty on the non-proliferation of nuclear weapons. Dated February 2nd, 1977.** *Bundesgesetzblatt, Teil 2;* No. 10, 232(Feb 1977). (In German).

The non-proliferation treaty, the instruments of ratification for Japan having been deposited on June 8th, 1976, and for Singapore on March 10th, 1976, has come into force. English and German

translations of a Japanese declaration in connection with the depositing are presented.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 42329

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

42394 (UCRL—80166) **Inertial confinement fusion targets.** Nuckolls, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Oct 1977. Contract W-7405-ENG-48. 5p. (CONF-780202—20). Dep. NTIS, PC A02/MF A01.

From Topical meeting on inertial confinement fusion; San Diego, CA, USA (7 Feb 1978).

ICF targets are discussed with respect to implosion, isentropic compression, and propagation physics. The different types of targets and some of their properties are described. (MOW)

PROPERTIES

42395 (HEDL-TME—78-15) **Lithium literature review: lithium's properties and interactions.** Jeppson, D.W.; Ballif, J.L.; Yuan, W.W.; Chou, B.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1978. Contract EY-76-C-14-2170. 109p. Dep. NTIS, PC A06/MF A01.

The lithium literature has been reviewed to provide a better understanding of the effects of lithium spills that might occur in magnetic fusion energy (MFE) facilities. Lithium may be used as a breeding blanket and reactor coolant in these facilities. Physical and chemical properties of lithium as well as the chemical interactions of lithium with various gases, metals and non-metals have been identified. A preliminary assessment of lithium-concrete reactions has been completed using differential thermal analysis. Suggestions are given for future studies in areas where literature is lacking or limited.

42396 (ORNL/TM—5963) **Tritium oxidation and exchange: preliminary studies.** Phillips, J.E.; Easterly, C.E. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

The radiological hazard resulting from an exposure to either tritium oxide or tritium gas is discussed and the factors contributing to the hazard are presented. From the discussion it appears that an exposure to tritium oxide vapor is 10^4 to 10^5 times more hazardous than exposure to tritium gas. Present and future sources of tritium are briefly considered and indicate that most of the tritium has been and is being released as tritium oxide. The likelihood of gaseous releases, however, is expected to increase in the future, calling to task the present general release assumption that 100% of all tritium released is as oxide. Accurate evaluation of the hazards from a gaseous release will require a knowledge of the conversion rate of tritium gas to tritium oxide. An experiment for determining the conversion rate of tritium gas to tritium oxide is presented along with some preliminary data. The conversion rates obtained for low initial concentrations (10^{-4} to 10^{-1} mCi/ml) indicate the conversion may proceed more rapidly than would be expected from an extrapolation of previous data taken at higher concentrations (10^{-1} to 10^{2} mCi/ml).

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

42397 **Separation of carbon and nitrogen isotopes by selective photodissociation azo or diazo compounds.** Chen, H.L. (to Energy Research and Development Administration). US Patent 4,064,025. 20 Dec 1970. Filed date 24 Nov 1976. 6p.

PAT-APPL-744,475.

Separation of isotopes, particularly of carbon or nitrogen, is achieved by the selective photodissociation of an azo compound or a diazoalkane, particularly azomethane or diazomethane.

HEAVY WATER PRODUCTION

42398 (UCID—17736-77-4) **Development of advanced concepts for improved heavy water production technology.** Aldridge, F.T.; Herman, I.P.; Marling, J.B.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1978. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

Two strongly differing processes for deuterium isotope separation continued under active experimental development during the reporting period. Compound development continued for chromatographic hydrogen isotope separation using intermetallic hydrides. Inexpensive alloys with calcium completely substituted for lanthanum showed good separation factors with fast equilibration times. Macroscopic separation of deuterium was achieved in a small laboratory column. Improved reactants were selected for the IR-laser deuterium halide-olefin addition reactions. An extensive chemical, spectroscopic and photochemical survey has been nearly completed to select the optimum working compound for the IR-laser deuterium separation process utilizing multiphoton dissociation. Several compounds have been selected for further detailed evaluation. Several new conceptual schemes for deuterium separation are presented.

RADIATION SOURCES

REFER ALSO TO CITATION(S) 43413

DESIGN AND FABRICATION

42399 (AD-A—046881) **Flash x-ray facility.** Moskaitis, J.V. (Naval Surface Weapons Center, Silver Spring, Md. (USA)). Aug 1977. 20p. (NSWC/WOL/MP—77-21). NTIS PC A02/MF A01.

The publication provides information for the convenience of potential users of the Flash X-Ray Facility located at Naval Surface Weapons Center, White Oak Laboratory. These flash x-ray machines provides the nuclear weapon effects community with the capability of simulating those effects in materials, electronic components, and circuits which are caused by the gamma ray output from a nuclear weapon. Included is information on the operating characteristics of the Febetron 705 and 706 flash x-ray machines, support capabilities, dosimetry, instrumentation, and travel.

42400 (AD-A—047295) **Status of the tactical environment multiple systems evaluation program (TEMSEP). Progress report.** Bombardt, J.N. Jr.; Dietz, J.F.W.; Merkel, G.; Spohn, D.J. (Harry Diamond Labs., Washington, D.C. (USA)). Oct 1977. 48p. (HDL-PR—77-2). NTIS PC A03/MF A01.

This report discusses technical progress made under the Tactical Environment Multiple Systems Evaluation Program (TEMSEP). The long and short range goals of the program are presented with particular emphasis on the topics of instrumentation in an ionizing radiation environment, basic phenomena associated with the electromagnetic pulse (EMP) generation within the nuclear source region, and laboratory simulation of the electromagnetic environment associated with the nearby (endoatmospheric) detonation of a nuclear weapon. Experiments used the AURORA Flash X-Ray Facility as a radiation source. Notable milestones accomplished were the experimental verification of the existence of the boundary layer phenomenon and verification of electromagnetic coupling models for simple structures.

OTHER INDUSTRIAL USES

42401 (AD-A—047788) **Conceptual design of a pilot wastewater irradiating facility. Final report.** Everline, C. (Army Facilities Engineering Support Agency, Fort Belvoir, Va. (USA). Research and Technology Div.). 1 Oct 1977. 131p. (USAFESA-RT—2025). NTIS PC A07/MF A01.

A conceptual design of a pilot wastewater irradiation treatment plant is discussed. The report is divided into three sections. The first section deals with the overall plant layout. This includes the interface to a conventional plant and radiation shield design. Part two examines peripheral equipment and the selection of a gamma ray source. Finally nuclear design considerations are discussed in part three.

HYDROGEN

PRODUCTION

42402 **Hydrogen as the new energy vector.** Nowacki, P.J. (Polska Akademia Nauk, Warsaw). *Arch. Energ.:* No. 4, 201-204(1976). (In Polish).

The importance of hydrogen as second energy-vector, besides electricity, is described in detail. The production of hydrogen by thermochemical methods and reforming is especially described and the normal methods like Lurgi and Koppers-Totzek as well as the KFA Juelich project Adam-Eva are also mentioned. The role of HTR reactor is specially stressed as source of many process-heat methods. The storage, transport and utilization of hydrogen and SNG are mentioned - as well as the role of fuel-cells and methanol for transport purposes.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 42461, 42463

STEAM-IRON PROCESS

REFER ALSO TO CITATION(S) 42122

PROPERTIES

REFER ALSO TO CITATION(S) 43389

42403 (LBL—7801) **Catalyzed combustion of H_2/air mixtures on a heated platinum plate.** Schefer, R.W.; Cheng, R.K.; Robben, F.A.; Brown, N.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 45p. (CONF-780417—4). Dep. NTIS, PC A03/MF A01.

From Western States Section/Combustion Institute; Boulder, CO, USA (17 Apr 1978).

Recent studies have indicated considerable promise in using surface catalysis directly in the combustion process in order to reduce the associated pollution. The study of combustion in the laminar boundary layer of a heated flat plate with a free stream flow of premixed fuel and air involves most of the important physical and chemical processes of catalytic systems while providing a suitable geometry for experimental study and numerical calculations. The experimental configuration consists of a thin quartz plate with vacuum deposited platinum heating stripes mounted over an open atmospheric pressure jet of premixed hydrogen and air. The boundary layer behavior of chemically reacting H_2/air mixtures over a heated catalytic platinum plate has been studied using a deflection mapping technique. Results are presented for a range of equivalence ratios from 0.0 to 0.3 at plate surface temperatures from 470 to 1300°K. Significant surface reaction was found for all mixtures at plate temperatures as low as 470°K. At increased equivalence ratios and temperatures, gas phase boundary layer combustion becomes apparent. Surface energy release rates were measured under conditions in which no gas phase reactions are present. Based on a one-step model for H_2 oxidation over platinum, a reaction rate expression is derived which correlates the data well.

42404 (N—78-10233) **Investigation of hydrogen-air ignition sensitized by nitric oxide and by nitrogen dioxide. Final report.** Slack, M.; Grillo, A. (Grumman Aerospace Corp., Bethpage, N.Y. (USA)). Oct 1977. Contract NAS1-14348. 43p. (NASA-CR—2896). NTIS PC A03/MF A01.

The sensitization of stoichiometric hydrogen-air ignition by NO, NO_2 and a mixture of NO and NO_2 was investigated behind reflected shock waves in a shock tube. Induction times were measured in pressure range 0.27 to 2.0 atm, temperature range 800 to 1500 K, and for NO or NO_2 mole percent between 0.0 and 4.5. Addition of both NO and NO_2 reduced the measured induction times. The experimental data are interpreted in terms of H_2-O_2-NO(x) oxidation reaction mechanisms. The influence of NO(x) upon a supersonic combustion ramjet combustor test, conducted in an arc-heated facility, is assessed.

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 43132, 43237

PREPARATION

CHEMICAL SYNTHESIS

42405 **Hydrogenation of CO and CO_2 over iron foils. Correlations of rate, product distribution, and surface composition.** Dwyer, D.J.; Somorjai, G.A. (Univ. of California, Berkeley). *J. Catal.;* **52**: No. 2, 291-301(Apr 1978).

The hydrogenation of CO and CO_2 over polycrystalline iron foils has been investigated under highly controlled conditions (6 atm, 3:1 H_2:CO, 300°C). The surface composition of the foil before and after high-pressure reaction was determined by Auger electron spectroscopy. The H_2/CO reaction produced C_1-C_5 hydrocarbons in detectable quantities. In this reaction the initially clean iron surface was rapidly covered by a monolayer of carbonaceous material that appeared to be the active surface. The specific methanation rate on this surface was 1.9 molecules $site^{-1}$ sec^{-1} with an activation energy of 27 +- 2 kcal $mole^{-1}$. The H_2/CO_2 reaction produced almost exclusively methane (97 mole%) and at a higher rate (10.9 molecules $site^{-1}$ sec^{-1}) than did the H_2/CO reaction. In both the H_2/CO and the H_2/CO_2 reactions the active surfaces were eventually poisoned by excessive deposition of carbon. The carbon-poisoned surfaces produced only methane but at much slower rates than did the active surfaces. Iron, without promoters, appears to be predominantly a methanation catalyst that poisons rapidly by the deposition of multilayers of carbon.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 42455, 42456, 42457, 43377, 43669

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 43377

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 42459, 43672

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 42458

42406 (PB—274718) **Drying Energy from corn cobs: a total system, 1976. (Energy in agriculture).** Horsfield, B.; Doster, D.H.; Peart, R.M. (Purdue Univ., Lafayette, Ind. (USA). Agricultural Experiment Station). Jun 1977. 11p. NTIS PC A02/MF A01.

This report presents a discussion on the successful and economical use of corn cobs as drying fuel. It is proposed that corn cobs could provide the necessary fuel for drying corn if: (1) there were sufficient energy in the corn cobs; (2) the cobs could be collected without interfering with harvest operations; (3) the cobs can be handled without additional labor or management requirements; (4) a satisfactory energy extraction method can be found which can put heated air into existing corn dryers; and (5) if the above can be done in a way that is economically justifiable. Each of the above conditions is evaluated with appropriate data included.

42407 **Evaluation of the efficiency of energy resource recovery systems.** Bailie, R.C.; Doner, D.M. (West Virginia Univ., Morgantown). *Resour. Recovery Conserv.;* **1**: No. 2, 177-187(Oct 1975).

The energy recovery potential of a resource recovery system is often represented by a single numerical value described as an energy efficiency. This paper details how various numerical values of efficiency can be provided for the same conversion process. To overcome such ambiguity, and to provide a method for comparing systems, a systematic method for evaluating the efficiency of recovery processes is developed which provides a single value for each conversion process. The method is applicable only as long as the conversion processes being compared produce the same energy products.

42408 **Current trends in municipal solid waste disposal in New York City.** Fenton, R. (Environmental Protection Administration, New York). *Resour. Recovery Conserv.;* **1**: No. 2, 167-176(Oct 1975).

Solid waste disposal is currently an active field in New York City with interest centered on alternatives to the incinerator and sanitary landfill. The history of refuse disposal and resource recovery in New York City is traced from the 1890's to the present to indicate the pioneering done here and as a reflection of national trends. The current trend in refuse disposal in New York City is distinctly directed toward resource recovery, particularly energy recovery. There is a local demand for resource recovery from the municipal waste stream: energy, steel and some types of paper are reasily marketable.

HYDRO ENERGY

RESOURCES AND AVAILABILITY

42409 **Power development in the North-Eastern Region.** *Bull. Inst. Eng. (India);* **27**: No. 5, 9-13(Nov 1977).

The North-Eastern Region of India is richly endowed with natural resources. It has vast potential for industrial development based on its mineral wealth and forest products. By far the most abundant of its resources is water power, which forms almost a third of the entire country's potential. Hydroelectric resources represent one of the cheapest sources of power and their rapid development can go a long way in accelerating industrial growth in the region. The region has also some coal deposits. Oil and gas is also located in the region and, in fact, it is one of the two areas in the country which contribute to indigenous production of crude. Despite these natural advantages, the economy of the region is relatively less developed. The per capita consumption of electricity, which is recognized as an index of industrial development and prosperity of any region, is very low, and is at present about 28 kWh compared to the all-India average of 109 kWh. Power development has, therefore, a special significance in the North-Eastern Region in order to bring up the economic level close to the all-India average.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 42651

42410 (IDO—10071) **Idaho Falls Hydroelectric Project. Preliminary report.** (International Engineering Co., Inc., San Francisco, Calif. (USA)). Feb 1978. Contract EG-77-A-07-1670. 173p. Dep. NTIS, MF A01.

Portions of document are illegible.

Preliminary studies and evaluation of the Idaho Falls Hydroelectric Project are described. Four alternatives for redeveloping the power potential of the Upper and Lower Power Plant Sites are presented and a development plan and a program for project implementation discussed. The results show that the recommended development is technically and economically feasible and that it is the most attractive of the alternatives investigated. It is recommended that the city proceed with early implementation of this development.

42411 **Economics of new hydro schemes: an analysis of alternate thermal.** Rikh, V.N. (UP State Electricity Board, Lucknow, India). *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 134-140(Dec 1977).

An optimum selection of operational features and design of a new hydro scheme is considerably more difficult than of a thermal scheme due to much greater flexibility available with the former in the choice of plant capacity, capacity of pondage/reservoir, pattern of water releases, etc. A comprehensive method of working out the economic viability of a new hydro scheme and comparative economics for different designs of a new hydro plant is presented. In this method, the cost of generation of hydro scheme is compared with that of an "alternative thermal" station, a typical thermal station which, if installed in lieu of the given hydro station, would operate under the same system conditions sharing similar proportion of peak and base load energy. With this method, an optimum selection of new hydro schemes to cater for future needs of a given power system is possible.

ENVIRONMENTAL ASPECTS

42412 (PB—274950) **Boundaries of analysis: an inquiry into the Tocks Island Dam controversy.** Feiveson, H.A.; Sinden, F.W.; Socolow, R.H. (American Academy of Arts and Sciences, Brookline, Mass. (USA)). 1976. 428p. American Academy of Arts and Sciences, Brookline, MA.

This is a study of what happens to technical analyses in the real world of politics. The Tocks Island Dam project proposed construction of a dam on the Delaware River at Tocks Island, five miles north of the Delaware Water Gap. Planned and developed in the early 1960s, it was initially considered a model of water resource planning. But it soon became the target of an extended controversy involving a tangle of interconnected concerns -- floods and droughts, energy, growth, congestion, recreation, and the uprooting of people and communities.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 42410

SOLAR ENERGY

REFER ALSO TO CITATION(S) 43120

42413 (HCP/T2322—01) **Solar energy: a comparative analysis to the year 2020.** Bennington, G.; Curto, P.; Miller, G.; Rebibo, K.; Spewak, P. (Mitre Corp., McLean, Va. (USA). METREK Div.). Mar 1978. Contract EX-76-C-01-2322. 66p. Dep. NTIS, PC A04/MF A01.

An energy data base, two primary scenarios reflecting trends in demand and energy prices, and a computer simulation model were developed. The energy data base contains engineering cost data on conventional and solar technologies based on the development of comparable generic system designs derived from reviews of the latest available information and studies from the federal solar program. The two scenarios are: (1) a scenario which incorporates the proposals in the National Energy Plan as proposed in April 1977 and (2) a scenario reflecting recent trends (since 1973) in energy prices, policy and technology. Projections of solar energy utilization and market impact are made by computer simulations of regional market decisions to purchase solar or conventional technologies in each market sector on a year-by-year basis to the year 2020.

42414 (N—77-31602) **Energy: a continuing bibliography with indexes, issue 12.** (National Aeronautics and Space Administration, Washington, D.C. (USA)). Jan 1977. 335p. (NASA-SP—7043(12)). NTIS PC E05.

This bibliography lists 584 reports, articles, and other documents introduced into the NASA scientific and technical information system from October 1, 1976 through December 31, 1976.

RESOURCES AND AVAILABILITY

42415 (CONF-770140—, pp 26-33) **Solar energy availability.** Buelow, F.H. (Univ. of Wisconsin, Madison). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The information that has been developed on the availability of solar energy is reviewed especially as it applies to grain drying systems. An attempt is made here to sort out appropriate information for grain drying applications, and then add procedures that may be the most helpful in the use of the information for research, design and planning activities. Measurements and instruments, angles of incidence, solar radiation data, and estimating solar availability are discussed.

42416 (CONF-770140—, pp 39-49) **Solar collector orientation.** Peterson, W.H. (South Dakota State Univ., Brookings). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The solar radiation received on a surface in a given time, on a clear day is shown for five surface orientations, two latitudes for seven different dates of the year. (MHR)

42417 (HCP/T2552—01) **On the nature and distribution of solar radiation.** (Watt Engineering Ltd., Cedaredge, Colo. (USA)). Mar 1978. Contract EX-76-C-01-2552. 265p. Dep. NTIS, PC A12/MF A01.

Radiation from the sun and the effects of the earth's atmosphere on the solar energy available over the U.S. are examined in detail. A model is developed which permits calculation of average values of direct normal insolation, diffuse insolation, and total horizontal (global) insolation. The inputs required are: (a) atmospheric moisture, (b) turbidity, and (c) cloud cover or percent sunshine. Insolation maps giving seasonal trends and annual average daily energy density values are presented for the direct normal term, the diffuse horizontal term, and the total horizontal (global) term. Comparisons are made between model outputs and observed values.

42418 (PB—273679) **Computations of solar insolation at Boulder, Colorado. Technical memo.** Pope, J.H. (National Environmental Satellite Service, Boulder, Colo. (USA)). Sep 1977. 20p. (NOAA-TM-NESS—93). NTIS PC A02/MF A01.

Computations of total solar insolation at a latitude and altitude appropriate for Boulder, Colo., were made with respect to solar declination angle. These computations were made for three hypothetical orientations of a collecting surface: a horizontal plane, a plane inclined perpendicular to the sun's rays at local noon, and a surface that is adjusted on a continuous basis so that it is always perpendicular to the solar rays. These calculations are made for each sunlight hour, the results of which are integrated with respect to

time to provide energy per day under each of the three cases as functions of solar declination angle.

42419 (UCRL—80429) **Effects of stratospheric perturbations on the solar radiation budget.** Luther, F.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 8p. (CONF-780613—02). Dep. NTIS, PC A02/MF A01.

From WMO symposium on geophysical aspects and consequences of changes in the composition of the stratosphere; Toronto, Canada (26 Jun 1978).

The changes in solar absorption and in local heating rates due to perturbations to O_3 and NO_2 concentrations caused by stratospheric injection of NO/sub x/ and CFM pollutants are assessed. The changes in species concentration profiles are derived from theoretical calculations using a transport-kinetics model. Because of significant changes in our understanding of stratospheric chemistry during the past year, the assessment of the effect of stratospheric perturbations on the solar radiation budget differs from previous assessments. Previously, a reduction in O_3 due to an NO/sub x/ injection caused a net decrease in the gaseous solar absorption;now the same perturbation leads to a net increase. The implication of these changes on the surface temperature is also discussed.

ECONOMICS

REFER ALSO TO CITATION(S) 42445, 43142, 43144, 43145, 43146

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 42479, 42480, 42496

42420 (PB—275565) **Illinois program for comprehensive solar energy legislation.** Green, B.D.; Pogany, D.Z.; Dunwoody, J.E. (Illinois Dept. of Business and Economic Development, Springfield (USA). Div. of Energy). Jun 1977. 42p. (ILLDOE—77/08). NTIS PC A03/MF A01.

This report examines the development of a Solar Energy Program in Illinois, including the formulation of the Comprehensive Solar Energy Act of 1977. A discussion of the need for comprehensive legislation precedes the overview of dynamics.

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 43143, 43146

42421 (N—78-10185) **Space station systems analysis study. Part 3: documentation. Volume 7: SCB alternate EPS evaluation, task 10.** (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Sep 1977. Contract NAS9-14958. 344p. (NASA-CR—151535). NTIS PC A15/MF A01.

Power levels up to 100 kWe average were baselined for the electrical power system of the space construction base, a long-duration manned facility capable of supporting manufacturing and large scale construction projects in space. Alternatives to the solar array battery systems discussed include: (1) solar concentrator/Brayton; (2) solar concentrator/thermionic; (3) isotope/Brayton; (4) nuclear/Brayton; (5) nuclear thermoelectric; and (6) nuclear thermionic.

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 42473, 42488, 42531, 42606

42422 (AD-A—046150) **Nonreflecting vertical junction silicon solar cell optimization. Interim report, May 1976—May 1977.** Wohlgemuth, J.; Lindmayer, J.; Scheinine, A. (Solarex Corp., Rockville, Md. (USA)). Jul 1977. Contract F33615-76-C-2058. 82p. NTIS PC A05/MF A01.

This work on nonreflective vertical-junction silicon solar cells has resulted in high conversion efficiency radiation resistant solar cells. New techniques of oxidation growth and the use of photolothography enable the use of an orientation dependent etch to produce grooves 5-10 micrometers wide and over 100 micrometers deep. These silicon wafers have been processed into solar cells with all of the processes performed at temperatures compatible with producing high efficiency solar cells. A theoretical calculation of the generated current for the vertical junction structure was performed. It indicates the decreased dependence on carrier diffusion length and, therefore, the reduced effect of radiation damage on collection efficiency for vertical junction solar cells. Vertical junction solar cells 2 cm x 2 cm in size have been fabricated with AMO conversion efficiencies greater than 13%. These cells have shown superior radiation resistance.

42423 (AD-A—047356) **Computer program for design and performance analysis of navigation-aid power systems program documentation. Volume II: User's Manual. Final report.** Goltz, G.; Weiner, H. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Jul 1977. 103p. (JPL—5040-27(Vol.2)(Change1)). NTIS PC A06/MF A01.

A computer program has been developed for designing and analyzing the performance of solar array/battery power systems for the U. S. Coast Guard Navigational Aids. This program is called the Design Synthesis/Performance Analysis (DSPA) Computer Program. The basic function of the Design Synthesis portion of the DSPA program is to evaluate functional and economic criteria to provide specifications for viable solar array/battery power systems. The basic function of the Performance Analysis portion of the DSPA program is to simulate the operation of solar array/battery power systems under specific loads and environmental conditions. This document provides all the information necessary to access the DSPA programs, to input required data and to generate appropriate Design Synthesis or Performance Analysis Output.

42424 (AD-A—047357) **Statistical analysis of NOAA solar/weather tapes. Program summary. Final report.** Goltz, G.; Kaiser, L.M.; Weiner, H. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Jun 1977. 52p. (JPL—5040-39). NTIS PC A04/MF A01.

A major mission of the U.S. Coast Guard is the task of providing and maintaining Maritime Aids to Navigation. These aids are located on and near the coastline and inland waters of the United States and its possessions. A computer program, Design Synthesis and Performance Analysis (DSPA), has been developed by the Jet Propulsion Laboratory to demonstrate the feasibility of low-cost solar array/battery power systems for use on flashing lamp buoys. To provide detailed, realistic temperature, wind, and solar insolation data for analysis of the flashing lamp buoy power systems, the two DSPA support computer program sets: MERGE and STAT were developed. A general description of these two packages is presented in this program summary report. The MERGE program set will enable the Coast Guard to combine temperature and wind velocity data (NOAA TDF-14 tapes) with solar insolation data (NOAA DECK-280 tapes) onto a single sequential MERGE file containing up to 12 years of hourly observations. This MERGE file can then be used as direct input to the DSPA program. The STAT program set will enable a statistical analysis to be performed of the MERGE data and produce high or low or mean profiles of the data and/or do a worst case analysis. The STAT output file consists of a one-year set of hourly statistical weather data which can be used as input to the DSPA program.

42425 (AD-A—047542) **Computer program for design and performance analysis of navigation-aid power systems program documentation. Volume III: programmer's manual. Final report.** Goltz, G.; Weiner, H. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Jul 1977. 166p. (JPL—5040-27(Vol.3)(Change1)). NTIS PC A08/MF A01.

A computer program has been developed for designing and analyzing the performance of solar array/battery power systems for the U.S. Coast Guard Navigational Aids. This program is called the Design Synthesis/Performance Analysis (DSPA) Computer Program. The basic function of the Design Synthesis portion of the DSPA program is to evaluate functional and economic criteria to provide specifications for viable solar array/battery power systems. The basic function of the Performance Analysis portion of the DSPA program is to simulate the operation of solar array/battery power systems under specific loads and environmental conditions. This document provides a detailed description of the DSPA Computer Program system and its subprograms. This manual will assist the programmer in revising or updating the several subprograms.

42426 (AD-A—047890) **Computer program for design and performance analysis of navigation-aid power systems. Program summary. Final report.** Weiner, H. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Jun 1977. 118p. (JPL—5040-27). NTIS PC A06/MF A01.

A computer program developed for the performance analysis of a spacecraft power system is capable of performing all the calculations necessary to understand the overall characteristics of solar array-barrery power systems for application to aids to navigation. The DSPA (Design Synthesis/Performance Analysis) Computer Program will ebable the Coast Guard to design solar array/battery power systems for aids to navigation having any specific flashing lamp load and at any geographical location, simulate the performance of solar array/battery power systems in operation on navigation aids under specific flashing lamp load and environmental conditions, and provide specifications for viable alternative designs which may be used to integrate solar array/battery power systems into the Coast Guard inventory. The DSPA Computer Program was verified by comparing the predicted operational characteristics of specified power systems with the actual performance of these same

power systems. The Computer Program accurately predicted the changes in battery state-of-charge over a one year period for two power systems considered successfully tested by the Coast Guard.

42427 (AD-A—048037) **Radiation effects on A1GaAs/GaAs solar cells using 0.9-3.0 MeV protons and 1.0-1.4 MeV electrons. Technical report 1 Jan—31 Dec 76.** Lowe, L.F.; Cappelli, J.R.; James, L.W.; Moon, R.L. (Rome Air Development Center, Griffiss AFB, N.Y. (USA)). Sep 1977. 33p. (RADC-TR—77-332). NTIS PC A03/MF A01.

Aluminum gallium arsenide solar cells were irradiated with 1.0 and 1.4 MeV electrons, and with 0.9 and 3.0 MeV protons to determine radiation sensitivity. Electron fluences ranged from 1 x 10 to the 14th power to 3 x 10 to the 16 power electrons, 1 sq cm, and proton fluences from 5 x 10 to the 10 power to 2.7 x 10 to the 12th power/sqcm. A solar simulator and a tungsten lamp were used to evaluate changes in the current-voltage characteristics curves. In most cases, AlGaAs solar cells showed a greater resistance to radiation than silicon cells.

42428 (AD-A—048042) **Solar cell design study. Final report 1 Apr 76—2 Jan 77.** Lamorte, M.F.; Hauser, J.R.; Littlejohn, M.A.; Simons, M. (Research Triangle Inst., Durham, N.C. (USA)). Aug 1977. Contract F33615-76-C-1283. 304p. (RTI—41U-1259). NTIS PC A14/MF A01.

This report reviews the present state-of-the-art in the technology of selected III-V compounds most applicable to solar cells. Emphasis is placed on those areas of III-V materials technology that can be advanced most effectively in the development of high efficiency solar cells for use in the near-earth space environment. Solar cell configurations evaluated or modeled include homojunctions, heterojunctions, Schottky barriers, graded-structures, and multijunction or cascade designs. (Author)

42429 (BNL—24216) **Amorphous semiconductors in photovoltaic and solar thermal conversion.** Griffith, R.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 6p. (CONF-780114—7). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

Amorphous semiconductor materials promise to play an important role in solar energy conversion. For photovoltaic applications, acceptable efficiencies eta in large-area Schottky cells may be possible if hole transport in a-Si can be improved. Indeed, in very small-area cells (approximately 1 mm^2) reasonable upper limits eta approximately 6 percent have been reported in the literature. For solar thermal applications, studies on Si/sub 1-x/B/sub x/ alloys point toward the realization of solar coatings that are stable at high temperatures, and that satisfy the dual requirement of high solar absorptance α/sub s/ and low infrared emittance e.

42430 (CONF-780114—8) **Design of CPC photovoltaic solar collectors.** Graven, R.M.; Gorski, A.J.; McIntire, W.R. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

Two new photovoltaic solar collectors have been designed, built and tested. A substantial improvement in performance has been achieved in that they produce more electrical power and use significantly less photovoltaic material per unit area than the present state-of-the-art flat panel arrays. A reflective style Compound Parabolic Concentrator (CPC) optical system was used for one collector, and a dielectric style (DCPC) optical system was used for the other collector to concentrate sunlight onto custom designed photovoltaic solar cells. For these two panels only periodic angular adjustments are required, which eliminates the need for two-axis tracking. A modular design of individual sub-units containing an array of series and parallel circuits allows a user to select a variety of operating conditions. The dielectric CPC panel can provide a peak voltage selected from the range of 6V to 120V dc, in steps of 6V, and a peak current from the range of 23A to 1.15A, in 1.15A increments, respectively. The modular design also allows rapid replacement and repair of individual sub-units. The mechanical assembly was designed to withstand a very heavy load of 250 Kg/m^2. The reflective CPC photovoltaic panel is 1.22m by 1.22m, requires thirty-six adjustments per year, and delivers 97 peak watts under 1 kW/m^2 of direct insolation. The dielectric CPC panel is also 1.22m by 1.22m, but only requires ten adjustments per year, and delivers 138 peak watts under 1 kW/m^2 of direct insolation. The net energy conversion efficiency over the entire dielectric CPC panel, including the frame, was 10.3%. The design considerations for these panels are summarized.

42431 (DOE/JPL/954343—10) **Process feasibility study in support of silicon material. Task I. Quarterly technical progress report (I).** Fang, C.S.; Hansen, K.C.; Miller, J.W. Jr.; Yaws, C.L. (Lamar Univ., Beaumont, Tex. (USA). Dept. of Chemical Engineering). Mar 1978. Contract NAS-7-100-954343. 81p. Dep. NTIS, PC A05/MF A01.

Major activities period centered on process system properties, chemical engineering and economic analyses. In analyses of process system properties, major efforts focused on properties of silicon tetrachloride which is the source material for several alternate processes under consideration for solar cell grade silicon production. The status and progress are reported for physical, thermodynamic and transport property data. Experimental determination of gaseous thermal conductivity of silicon source materials was continued. For chemical engineering analyses, the preliminary process design for the original silane process was completed for Cases A and B, Regular and Minimum Process Storage. Included are raw material useage, utility requirements, major process equipment list, and production labor requirements. The preliminary process design results for Cases A and B were used for economic analyses.

42432 (DOE/JPL/954356—4) **Dip-coating process. Silicon sheet growth development for the large-area silicon sheet task of the low-cost silicon solar array project. Quarterly report No. 7.** Zook, J.D.; Heaps, J.D.; Maciolek, R.B.; Koepke, B.; Butter, C.D.; Schuldt, S.B. (Honeywell Corporate Material Sciences Center, Bloomington, Minn. (USA)). 30 Dec 1977. Contract NAS-7-100-954356. 58p. Dep. NTIS, PC A04/MF A01.

The objective of this research program is to investigate the technical and economic feasibility of producing solar-cell-quality sheet silicon by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. During the past quarter, significant progress was demonstrated in several areas. Seeded growth of silicon-on-ceramic (SOC) with an EFG ribbon seed was demonstrated. Different types of mullite received from Coors were successfully coated with silicon. A new method of deriving minority carrier diffusion length, L/sub n/, from spectral response measurements was evaluated. ECOMOD cost projections were found to be in good agreement with the interim SAMIS method proposed by JPL. On the less positive side, there was a decrease in cell performance which is believed to be due to an unidentified source of impurities. Also, operation of the new coating system fell behind schedule but is expected to improve in the coming quarter, since construction has now been completed.

42433 (DOE/JPL/954458—7) **Accelerated/abbreviated test methods, Study 4 of Task 3 (encapsulation) of the Low-Cost Silicon Solar Array Project. Seventh quarterly progress report, October—December 1977.** Kolyer, J.M.; Mann, N.R. (Rockwell International Corp., Anaheim, Calif. (USA). Autonetics Strategic Systems Div.). 3 Jan 1978. Contract NAS-7-100-954458. 16p. Dep. NTIS, PC A02/MF A01.

Successful predictions for the rate of loss of properties on outdoor exposure were made for plastic films based upon accelerated data. Degradation data for samples exposed beginning in winter, summer, or fall are discussed. The electrical performance of solar cells in Universal Test Specimens exposed outdoors is also reported. (MHR)

42434 (DOE/JPL/954559—4) **Solar silicon via the Dow Corning Process. Quarterly report No. 6.** Hunt, L.P.; Dosaj, V.D.; McCormick, J.R. (Dow Corning Corp., Hemlock, Mich. (USA). Solid-State Research and Development Lab.). Jan 1978. Contract NAS-7-100-954559. 16p. Dep. NTIS, PC A02/MF A01.

Quartz, as the silicon source material, has been identified to be plentifully available at a sufficient purity and reactivity to meet the objective of this program. Further investigations of deposits are warranted when the program reaches a higher level of development. Carbon, as a reductant for quartz, must be made available so as to have suitable reactivity in conjunction with high purity, especially with respect to boron and phosphorus. A detailed experimental plan has been developed to do this. Different sources of carbon have been selected to be subjected to various purification methods and reactivity-enhancement processes. A developmental-scale arc furnace has been installed and will undergo start-up during January. This equipment will be ready next quarter to perform quartz-carbon reactivity testing. An updated economic analysis of the Dow Corning Process for SoG-Si shows the manufacturing cost to be $7.37/kg (January 1975 dollars) at a level of 2700 metric tons per year. The capital investment would be $38.2 million.

42435 (DOE/JPL/954559—5) **Solar silicon via the Dow Corning Process. Seventh quarterly report, January—March 1978.** Hunt, L.P.; Dosaj, V.D.; McCormick, J.R. (Dow Corning Corp., Hemlock, Mich. (USA). Solid-State Research and Development Lab.). Apr 1978. Contract NAS-7-100-954559. 14p. Dep. NTIS, PC A02/MF A01.

Installation of the Direct Arc Reactor (DAR) system was completed. Reactor start-up was initiated after modifications were made as recommended by the safety start-up team. A series of experiments was started aimed at establishing baseline operating conditions for the DAR. These experiments use pure quartz and

unpurified charcoal as reactants. Two baseline experiments were completed. The longest experiment (48h) was terminated on schedule after producing 110 kg of silicon. After initial reactor conditioning, silicon was produced at 2.6 kg/h using 28 kWh/kg. A program was developed with the goal of identifying various carbon reductants having boron and phosphorus concentrations of about 1 ppm or less. The necessity is stressed of carrying out a development program for silicon purification by unidirectional solidification. This must be done in parallel with the development program for DAR-silicon production in order to develop the overall Dow Corning Process for solar-grade silicon within the time goals of the LSSA Project. The technology for unidirectional solidification requirements under the Dow Corning Process neither exist nor are they being developed.

42436 (DOE/JPL/954654—3) **Silicon Web process development. Low Cost Solar Array Project, Large Area Silicon Sheet Task. Third quarterly report, October 1, 1977—December 31, 1977.** Duncan, C.S.; Seidensticker, R.G.; McHugh, J.P.; Blais, P.D.; Davis, J.R. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Research and Development Center). 1977. Contract NAS-7-100-954654. 52p. Dep. NTIS, PC A04/MF A01.

The experimental phase of the program was oriented toward developing growth configurations which produced crystals having low residual stress levels. It was found that some slot designs, especially thick lids with narrow slots tended to produce crystals with high residual stress, however these lids also were conducive to melts with minimal temperature fluctuations and relatively flat temperature profiles. Several runs were also made to evaluate the properties of a 106 mm diameter round crucible which in principle should have a superior thermal profile. Thermal modeling efforts were directed to developing finite element models of both the 106 mm round crucible and an elongated susceptor/crucible configuration for the new furnace system. The model for the larger round crucible was completed and predicted a very satisfactory temperature distribution. Additionally, the separate thermal model for the heat loss modes from the dendritic web itself was examined for guidance in reducing the thermal stress in the web. An economic analysis has been prepared in order to evaluate the silicon web process present and expected future status as related to the 1982 and 1986 price goals.

42437 (DOE/JPL/954694—4) **Analysis of effects of impurities intentionally incorporated into silicon. Final report, Feburary 1, 1977—December 1, 1977.** Uno, F. (Spectrolab, Inc., Sylmar, Calif. (USA)). 15 Dec 1977. Contract NAS-7-100-954694. 25p. Dep. NTIS, PC A02/MF A01.

A methodology has been developed and implemented to allow silicon samples containing intentionally incorporated impurities to be fabricated into finished solar cells under carefully controlled conditions. The electrical and spectral properties were then measured for each group processed, and this data, along with all the material, (cells and scrap) were delivered to JPL for further analysis. All 33 lots of Group "C", 14 lots of Group "CM" and 16 lots of Group "F" have been fabricated into cells, tested and delivered to JPL.

42438 (DOE/JPL/954831—77/12) **High efficiency, long life terrestrial solar panel. First quarterly report, 1 September 1977—30 November 1977.** Chao, T.; Khemthong, S.; Ling, K.; Olah, S. (Optical Coating Lab., Inc., City of Industry, Calif. (USA). Photoelectronics Div.). 1977. Contract NAS-7-100-954831. 24p. Dep. NTIS PC 02/MF A01.

The design of a high efficiency, long life 80-W terrestrial module has been completed. It utilizes 256 rectangular, high efficiency solar cells to achieve high packing density and electrical output. Tooling for the fabrication of solar cells is in house and evaluation of the cell performance has begun. Based on the power output analysis, the goal of a 13% efficiency module is achievable.

42439 (DOE/JPL/954862—1) **Development of a model and computer code to describe solar grade silicon production processes. First quarterly report.** Gould, R.K. (Aerochem Research Labs., Inc., Princeton, N.J. (USA)). Feb 1978. Contract NAS-7-100-954862. 27p. (AeroChem-TN—184). Dep. NTIS, PC A03/MF A01.

It is proposed to develop a mathematical model and a computer code based on this model, which will allow prediction of the product distribution in chemical reactors in which gaseous silicon compounds are converted to condensed-phase silicon. The reactors to be modeled are flow reactors in which silane or one of the halogenated silanes is thermally decomposed or reacted with an alkali metal, H_2 or H atoms. Because the product of interest is particulate silicon, processes which must be modeled, in addition to mixing and reaction of gas-phase reactants, include the nucleation and growth of condensed Si via coagulation, condensation, and heterogeneous reaction. The most recent version of a free shear layer turbulent mixing code (LAPP) which treats finite rate, gas-phase chemistry has been acquired and documented to ascertain exactly the numerous changes the code has undergone in recent years. Equations describing particle dynamics have been formulated and are being coded. A code for calculating particle coagulation rates is available; it will be recoded, combined with a nucleation model, and inserted into the LAPP code. A model for calculating nucleation rates has been selected from among several alternatives; the rate coefficients and thermochemical information needed for its utilization are currently being developed.

42440 (DOE/JPL/954876—1) **Development and evaluation of die and container materials. First quarterly progress report, October 1—December 31, 1977. Silicon Sheet Task, Low Cost Silicon Solar Array Project.** Wills, R.R.; Neisz, D.E. (Battelle Columbus Labs., Ohio (USA)). 18 Jan 1978. Contract NAS 7-100-954876. 40p. Dep. NTIS, PC A03/MF A01.

The JPL Low Cost Silicon Solar Array Project has been established with the goal of decreasing the cost of solar photovoltaic arrays for electrical power generation. Methods of producing silicon sheet for solar cells are under active development as one of several tasks designed to achieve this objective. In the crystal growing processes a refractory crucible is required to hold the molten silicon while in the ribbon processes an additional refractory shaping die is needed to enable silicon ribbon to be produced. In several ribbon processes the high temperature materials are a limiting factor in the development of the technique. The objective of this study is to develop and evaluate refractory die and container materials. First quarter studies are reported. Commercial high purity ultrafine Si_3N_4, Al_2O_3 and SiO_2 powders were vacuum dried and stored under nitrogen in sealed containers. Extensive analysis of the chemical, physical and morphological characteristics of these powders has been performed. The preparation of high purity A1N powder is being investigated by elevated temperature gas phase nucleation reactions involving (1) the reaction of $AlCl_3(g)$ and NH_3 and (2) the reaction between AlCl(g) and NH_3. While optimization of reaction (1) has not been completed, it appears that this process will only give low yields. Preliminary evaluation of reaction (2) has not yet proceeded far enough to permit definitive analysis of results. The interaction of molten silicon with fused quartz was examined in a Knudsen cell using a mass spectrometer. The solubility of oxygen at the melting point of silicon was calculated to be 1.78×10^{18} atoms/cm^3, and the activity coefficients of oxygen and silicon monoxide, the major vapor species, were calculated to be 4.83×10^{-24} and 7.01×10^{-5}, respectively.

42441 (HCP/T7405—1) **Cu/sub x/S-(Cd,Zn)S photovoltaic solar energy converters. Quarterly report No. 2, July—September 1977.** Peterson, T.M.; Chin, B.L.; Seshan, K.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1977. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Reproducible growth of uncracked, >10 μm thick films of (Cd,Zn)S has been accomplished on the As(antis 111) face of GaAs substrates and on substrates tilted approximately 14° off of (antis 111). Modifications to the hot wall deposition apparatus have been made to eliminate the trace impurities which had been sometimes found at the perimeter of the films. Techniques for transmission electron microscope specimen preparation have been developed. The initial TEM results have yielded evidence supporting the earlier proposed mechanism of Ga-face film cracking by an interfacial layer of GaS. The spectral response portion of the new device measurement apparatus is operational. The elastic tunneling calculations have been found to agree with experimental results reported by other workers for I-V characteristics of illuminated cells.

42442 (N—77-32590) **Automated fabrication of back surface field silicon solar cells with screen printed wraparound contacts. Final report.** Thornhill, J.W. (Spectrolab, Inc., Sylmar, Calif. (USA)). Aug 1977. Contract NAS3-20029. 49p. (NASA-CR—135202; REPT—380-5313). NTIS PC A03/MF A01.

The development of a process for fabricating 2 x 4 cm back surface field silicon solar cells having screen printed wraparound contacts is described. This process was specifically designed to be amenable for incorporation into the automated nonvacuum production line. Techniques were developed to permit the use of screen printing for producing improved back surface field structures, wraparound dielectric layers, and wraparound contacts. The optimized process sequence was then used to produce 1852 finished cells. Tests indicated an average conversion efficiency of 11% at AMO and 28 C, with an average degradation of maximum power output of 1.5% after boiling water immersion or thermal shock cycling. Contact adherence was satisfactory after these tests, as well as long term storage at high temperature and high humidity.

42443 (NSF-AER—75-19576-1) **Ternary compound thin film solar cells-I. First quarter report, September 1—December 31, 1976.** Kazmerski, L.L. (Maine Univ., Orono (USA). Dept. of Electrical Engineering). Jan 1977. 64p. Dep. NTIS, PC A04/MF A01.

The growth and structural characterization of vacuum deposited, n- and p-type $CuInTe_2$ thin films, utilizing a high evaporation-

rate technique (>100A/sec), are reported. Complementary transmission electron microscopy (TEM) and Auger electron microscopy (AES) are used to investigate the films' crystalline and compositional properties. A substrate-temperature range (400K < T/sub sub/ < 525K) has been identified for the growth of single phase, chalcopyrite $CuInTe_2$. The electrical properties - mobility, conductivity, carrier type and carrier concentration - are reported. A thin-film CdS/$CuInTe_2$ heterojunction has been fabricated. Dark IV-characteristics are presented for in-situ provided devices. The photovoltaic effect for this heterostructure is discussed. Finally, the fabrication and characterization of n, p-$CuInS_2$ thin film homojunction solar cells are presented. Dark and light IV-characteristics are reported for 0.124 cm^2 devices, with typical parameters: eta = 3.33%, V/sub oc/ = 0.41v, I/sub sc/ = 2.34 mA and FF = 0.43. A best efficiency of 3.62% is cited. Spectral response characteristics are presented, and device stability is discussed.

42444 (NSF/AER—75-19576-2) **Ternary compound thin film solar cells-II. Second quarter report, January 1—March 31, 1977.** Kazmerski, L.L. (Maine Univ., Orono (USA). Dept. of Electrical Engineering). Apr 1977. 36p. Dep. NTIS, PC A03/MF A01.

The fabrication and performance of several vacuum-deposited thin-film photovoltaic devices using I-III-VI_2 chalcopyrite semiconductors are presented. The heterojunctions CdS/$CuInS_2$ and CdS/$CuInSe_2$ are described with measured solar-conversion efficiencies of 3.25 percent and 6.6 percent respectively. Little photovoltaic response is observed in the CdS/$CuInTe_2$ heterostructure. The photovoltaic effect in the first n,p $CuInS_2$(3.6 percent) and n,p $CuInSe_2$ (3.0 percent) thin-film homojunctions is demonstrated. Light and dark J-V characteristics, spectral responses and device parameters (efficiencies, fill-factor, open-circuit voltages, short-circuit currents and dark saturation currents) are reported for all these devices. Finally, the structure and stability of these ternary-based devices are examined, and Auger electron spectroscopy (AES) is utilized to identify possible device degradation mechanisms under various environmental conditions. In the case of the heterojunctions, depth-compositional profiling is used to determine the grain boundary diffusion coefficients of Cd from the CdS in the ternary thin films.

42445 (PB—273969) **DOD photovoltaic energy conversion systems market inventory and analysis. Volume I.** Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G. (BDM Corp., Vienna, Va. (USA)). Jun 1977. 219p. NTIS PC A10/MF A01.

This report provides estimates of the potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development. The focus of the study is on delineating near-term markets. It is hoped that rapid development of these markets will provide sufficient sales volume to promote industry automation and drive down the unit cost of photovoltaic energy systems to the point where large-scale DOD and civilian markets will develop.

42446 (PB—273970) **DOD photovoltaic energy conversion systems market inventory and analysis. Volume II.** Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G. (BDM Corp., Vienna, Va. (USA)). Jun 1977. 285p. NTIS PC A13/MF A01.

Contents include: Statement of work; Near-term application of P/V energy systems--detailed data and results; Long-term application of P/V energy systems--detailed data and results; Combined energy systems; Market survey of technology transfer potential of DOD photovoltaic applications; and Technology transfer potentials for non-DOD applications.

42447 (PB—273971) **DOD photovoltaic energy conversion systems market inventory and analysis. Summary volume.** Terry, R.M.; Carter, C.P.; Israel, J.; Merrill, O.H.; Semmans, M.G. (BDM Corp., Vienna, Va. (USA)). Jun 1977. 40p. NTIS PC A03/MF A01.

This report provides estimates of the potential Department of Defense market for photovoltaic energy systems, and the potential role of the DOD in promoting industry and market development. The focus of the study is on delineating near term markets. It is hoped that rapid development of these markets will provide sufficient sales volume to promote industry automation and drive down the unit cost of photovoltaic energy systems to the point where large scale DOD and civilian markets will develop.

42448 (PB—274220) **Preliminary analysis of an option for the federal photovoltaic utilization program. Headquarters contract pub.** Merrill, O.H.; Belote, J.C.; Hamilton, M.R.; Hauger, J.S.; Israel, J. (BDM Corp., Vienna, Va. (USA)). Nov 1977. 59p. NTIS PC A04/MF A01.

The intention of the Program is to provide significant, cost effective incentive for the accelerated development of an innovative highly competitive industry capable of producing low cost, quality, photovoltaic systems. This industry would be capable of supplying the private sector with a major source of clean, non-depletable electrical energy. As a secondary benefit, the Federal government is expected to realize significant net cost savings. The option analyzed in this report would consist of a series of federal procurements resulting in the installation of 152 megawatts peak of photovoltaic arrays over a five year period.

42449 (SAN—1101/PA8-1/4) **Mission analysis of photovoltaic solar energy conversion. Volume IV. Supplementary studies.** Leonard, S.L.; Breisacher, P.; Munjal, P.K.; Neiss, J.A. (Aerospace Corp., El Segundo, Calif. (USA). Energy and Transportation Div.). Mar 1977. Contract EY-76-C-03-1101. 131p. Dep. NTIS, PC A07/MF A01.

A discussion is presented of the most significant problems associated with the production and deployment of photovoltaic arrays. The principal chemical compounds to be used in the manufacture of silicon, gallium arsenide, and cadmium sulfide photovoltaic arrays are discussed with respect to physical and chemical properties, sources of the raw materials required to extract or synthesize these materials, the methods of manufacture, storage and handling in large quantities, transportation restrictions, spills, leaks, ignition and explosion. A discussion of safety hazards associated with the finished products is followed by an analysis of the toxicological properties of all raw, refined, and finished chemical species involved. The principal tool used in the evaluation of incentive strategies was a new Public Utility Financial Analysis and Planning Model which is described in some detail. After adaptation to match the characteristics of photovoltaic plants, it was used in the comparative evaluation of six different incentive strategies. The candidate strategies, the rationale for their selection, and the results of the comparative evaluation are presented. An account is given of an attempt to assess the full non-internalized costs of coal-fired power generation. A detailed description is given of the various damage elements and their associated societal costs for coal production, coal transportation, and coal-fired power generation. (MHR)

42450 (SAN—1284-T1) **Thin films of gallium arsenide on low-cost substrates. Quarterly project report No. 1, September 1, 1976—November 30, 1976.** Chu, S.S. (Southern Methodist Univ., Dallas, Tex. (USA)). Dec 1976. Contract EY-76-C-03-1284. 32p. Dep. NTIS, PC A03/MF A01.

Efforts have been directed to the construction of gallium arsenide deposition apparatus, the preparation of substrates, and the deposition of gallium arsenide films. Two gallium arsenide deposition systems suitable for the deposition of uniform gallium arsenide films on large area substrates by the reaction of gallium, hydrogen chloride, and arsine have been constructed. Germanium and tungsten films were deposited on graphite supports by the thermal reduction of germanium tetrachloride and tungsten hexafluoride, respectively. Both films are polycrystalline with crystallite size of 5-40 μm. Attempts to increase the crystallite size in germanium were not successful since molten germanium was not wet by graphite. This problem was overcome by using a tungsten interlayer. Gallium arsenide films have been deposited on single crystalline gallium arsenide, single crystalline germanium, tungsten/graphite, and germanium (recrystallized)/tungsten/graphite substrates. Gallium arsenide films deposited on single crystalline gallium arsenide and germanium substrates were epitaxial with respect to the substrate. Gallium arsenide films deposited on tungsten/graphite substrates were uniform with an average crystallite size of about 10 μm, while those on germanium (recrystallized)/tungsten/graphite substrates were non-uniform with considerably larger crystallites. The use of germanium (recrystallized)/tungsten/graphite as a substrate for the deposition of gallium arsenide films appears to be encouraging.

42451 (SAN—1285-1) **Thin films of silicon on metallurgical silicon substrates: Phase II. Quarterly project report No. 1, September 1, 1977—November 30, 1977.** Chu, T.L. (Southern Methodist Univ., Dallas, Tex. (USA)). Dec 1977. Contract EY-76-C-03-1285. 41p. Dep. NTIS, PC A03/MF A01.

It is proposed to investigate thin films of silicon on metallurgical silicon substrates and to demonstrate an AM1 efficiency of 10 percent for large area (30 cm^2) thin film silicon solar cells by August 1979. Efforts during the past quarter have been directed to the purification of metallurgical silicon, the preparation of substrates, and the fabrication and characterization of solar cells. Efforts have also been directed to the determination of dopant profiles in solar cells by the spreading resistance technique, the characterization of spectral response variations in solar cells by scanning, and the use of chemical vapor deposited tin oxide films as antireflection coatings.

42452 **Light concentrating solar cell cover.** Meulenberg, A. Jr. (to Communications Satellite Corp.). US Patent 4,053,327. 11 Oct 1977. Filed date 24 Sep 1975. 4p.

A cover slide for a solar cell comprises a plurality of converging lenses arranged to focus the incident light so that it does not fall on the grid lines of the front electrode of the solar cell.

42453 **Solar cells with concentrators.** Mlavsky, A.I.; Winston, R. (to Mobil Tyco Solar Energy Corp.). US Patent 4,045,246. 30 Aug 1977. Filed date 11 Aug 1975. 8p.

The invention provides a unique arrangement for cooling solar cells that are associated with collectors for collecting solar radiation and concentrating the same on the solar cells. The solar energy concentrators are each characterized by having a chamber with a solar radiation transmissive entrance wall, sidewalls adapted to concentrate solar radiation, one or more solar cells disposed in each chamber, and means for passing a dielectric, transparent cooling fluid through each chamber. The cooling fluid has an index of refraction which promotes solar energy concentration onto the solar cells in addition to that provided by the sidewalls.

THERMIONIC AND THERMOELECTRIC CONVERSION

REFER ALSO TO CITATION(S) 42531, 43152

42454 (LA-UR—78-1050) **Thermionic topping of a solar power plant using converters containing lanthanum hexaboride electrodes.** Storms, E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 12p. (CONF-780447—3). Dep. NTIS, PC A02/MF A01.

From Solar Thermal Test Facilities Users Association meeting; Golden, CO, USA (11 Apr 1978).

Properties of lanthanum borate for use as a thermionic emitter in a thermionic converter were studied, and results are presented and discussed. The vaporization rate of atoms from lanthanum borate, the work function, and the effect of cesium on these two properties were studied. (WHK)

BIOMASS PRODUCTION AND CONVERSION

42455 (COO—2917-8) **Biological conversion of biomass to methane, the effect of reactor design on kinetics.** Geisser, H.R.; Pfeffer, J.T. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). Dec 1977. Contract EY-76-S-02-2917. 65p. Dep. NTIS, PC A04/MF A01.

An experimental program was conducted to evaluate the effect of reactor type on methane production. This study showed that if a balanced population of organisms can be maintained in the initial stage, multi-stage fermentation is more efficient than a complex mix system. However, when the system is stressed, failure in the multi-stage system is more rapid. If the objective is to maximize the conversion of solids to methane, a staged system will produce more methane per unit volume of reactor. If the objective is to maximize the methane production per unit volume of reactor, a single stage complete-mix reactor operating near the critical retention time is required.

42456 (COO—2952-14) **Monfort waste conversion demonstration. Quarterly progress report, April 1, 1977—June 30, 1977.** Turk, M. (United Technologies Corp., Windsor Locks, Conn. (USA). Hamilton Standard Div.). Jul 1977. Contract EY-76-C-02-2952. 51p. Dep. NTIS MF A01.

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Progress in development of the mobile fermentation system at the Montfort cattle feedlots is reported. Fermentor startup was evaluated at operating conditions of 135°F/57.2°C with gradual increases in loading rates. An attempt was made to maintain the TVA (total volatile acid) concentration at a low level, but it became obvious that increases in loading rates could not be accomplished without a concomitant increase in TVA. Samples were also analyzed for heavy metals (Cu, Zn, Fe, Al) and S and P. Addition of $FeCl_3$ helped to reduce P, S, and TVA levels, making possible the maintenance of a healthy microbial colony capable of accepting increases in organic loading. (JGB)

42457 (COO—4388-1) **Acetic acid production from marine algae. Progress report No. 1, July 1—September 30, 1977.** Sanderson, J.E.; Augenstein, D.C.; Wise, D.L. (Dynatech R/D Co., Cambridge, Mass. (USA)). 14 Oct 1977. Contract EG-77-C-02-4388. 37p. Dep. NTIS, PC A03/MF A01.

Progress is reported in research designed to develop an economically competitive process for producing acetic acid from biomass for the purpose of sparing petroleum for other uses, to evaluate marine algae as a potential source of biomass, and to document the feasibility of running fermentations in fixed packed bed fermenters. It was demonstrated that marine algae can be fermented to acetic acid. Initial rates of up to 168 meq/l day were observed. These rates are substantially in excess of the 47 meq/l day used in the economic projections. Also, when using marine algae as a substrate, acid levels were generated equivalent to the highest reported with other substrates. It was also demonstrated that a 4-foot fixed packet bed fermenter may be operated with marine algae as a substrate at 20 percent solids or 200 meq/l.

42458 (HCP/T0285—01) **Biomass energy success stories: a portfolio illustrating current economic uses of renewable biomass energy.** (Biomass Energy Inst., Inc., Winnipeg, Manitoba (Canada)). Mar 1978. Contract EG-77-X-10-0285. 57p. Dep. NTIS, PC A04/MF A01.

Twenty-one illustrations of the use of energy from biomass by the sugar, pulp and paper, manufacturing, and wood products industries and for space heating of residences and institutional buildings are presented. Uses include the combustion of wood wastes and sugarcane residues for production of industrial electric power needs, steam production for bleaching and dyeing operations, heat for industrial drying, and space heating. The six appendices give information on the overall availability of biomass and biomass residues in the US and Canada. (JGB)

42459 (LBL—6881) **Process development studies on the bioconversion of cellulose and production of ethanol.** Wilke, C.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Feb 1978. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Progress is reported on studies on the NO—O_2 pretreatment of wheat straw prior to enzymatic hydrolysis. Studies of the conversion of xylose to ethanol by Fusarium oxysporum were continued. Progress is also reported on pilot plant process development and design studies on continuous cellulase production, enzyme recovery, batch cellulase enzyme production from Trichoderma viride, and kinetic modelling of the enzymatic hydrolysis of 5 percent newsprint. (JGB)

42460 **Sunny side of the future.** Calvin, M. (Univ. of California, Berkeley). *CHEMTECH;* 7: No. 6, 352-363(Jun 1977).

Possible applications of photosynthetic processes for energy production are outlined. Methods of quantum collection and heat collection are given. The status of the production of fuels and chemical fdedstocks from sugar cane in the U.S. and Brazil is discussed. Means for supplying nitrogen fertilizers are suggested. Rubber and other hydrocarbon-producing plants are also seen as making a real contribution toward helping to resolve the energy crisis. Model systems of photosynthetic solar energy conversion are discussed and illustrated. (JGB)

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

42461 (LA-UR—78-1052) **Solar-thermochemical production of hydrogen from water.** Cox, K.E.; Bowman, M.G. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 16p. (CONF-780447—2). Dep. NTIS, PC A02/MF A01.

From Solar Thermal Test Facilities Users Association meeting; Golden, CO, USA (11 Apr 1978).

There is a widespread interest in the development of a "hydrogen economy" as an eventual solution to many of the problems associated with the growing energy crisis. Hydrogen is also valuable as a chemical intermediate. As fossil sources become inadequate, large scale hydrogen production must utilize energy sources such as solar energy for the decomposition of water by thermochemical cycles, electrolysis or perhaps, by a hybrid combination of these methods. The potential higher efficiency and lower cost for thermochemical methods, versus the overall electrolysis path has been rather widely recognized. The criteria for the selection of an appropriate thermochemical cycle for matching with a high temperature solar heat source are detailed. Advantages of a thermochemical cycle based on a solid sulfate decomposition that makes use of isothrmal high temperature energy is detailed and a plan for the implementation of such a cycle on a central tower solar receiver is given.

42462 (PB—275218) **Photochemical conversion of solar energy. Quarterly progress report 1 Jul—30 Sep 75.** Lichtin, N.N. (Boston Univ., Mass. (USA). Dept. of Chemistry). 31 Oct 1975. 17p. NTIS PC A02/MF A01.

Topic include: (1) research on dependence of photogalvanic efficiency on cell parameters; (2) research on dependence of the output of the iron-methylene blue TI-TL SnO_2/Pt cell on solution composition and light intensity; (3) research on photochemistry of the iron-thionine and iron-methylene blue system in aqueous and non-aqueous media; and (4) research on bulk back reaction between Fe(III) and leucomethylene blue (MBH2(+)) or leucothionine (Th3(+)).

42463 **Solar power system.** Diggs, R.E. US Patent 4,030,890. 21 Jun 1977. Filed date 20 Oct 1975. 12p.

An apparatus and method is described for separating hydrogen and oxygen from water molecules. A solar reflecting means reflects solar energy onto a water containing tank to boil water and form steam. The steam is transferred either to a turbine-generator assembly for producing power, or to a dissociating means for producing hydrogen and oxygen. The steam in the dissociating means is forced to traverse a spiral path wherein it undergoes a circular motion to subject it to centrifugal force while contacting a heat transfer surface. Solar energy is concentrated on the heat transfer surface and heat in amounts sufficient to raise the temperature of the

steam to the dissociation temperature thereof is transferred thereto. Hydrogen and oxygen are separated from each other by the centrifugal forces, and are withdrawn from the dissociating means. An electric starter and means for moving solar reflecting means are also disclosed.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 42421, 42445

42464 (ALO—2744-13(Vol.5)) **Conceptual design and systems analysis of photovoltaic power systems. Final report. Volume V. Additional studies.** Pittman, P.F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Research and Development Center). Mar 1977. Contract EY-76-C-04-2744. 357p. Dep. NTIS, MF A01.

Portions of document are illegible.

In the first of four tasks, the performances of autonomous (stand-alone) residences were determined in seven locations throughout the country. A non-autonomous residence must obtain its supplemental energy from a utility. The second task dealt with considerations of the rate to be charged by the utility for this energy in an effort to define the pertinent issues of this utility/residence interface. In the third task, the configuration of a fixed linear Fresnel lens provided with a tracking absorber was analyzed optically. The fourth task explored utility Loss-of-Load probability methodology.

42465 (N—77-32229) **ATS-6 power system: hardware implementation and orbital performance.** Lavigna, T.A.; Hornbuckle, F.L. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1977. 49p. (NASA-TP—1023; G—7703X10). NTIS PC A03/MF A01.

The Applications Technology Satellite-6 power system, a shunt-boost configuration, uses partial shunt regulation of the solar array and a boost regulator for control of battery power. Regulation is provided for three different operating modes: shunt, charge, and boost. This configuration achieves the highest efficiency of power transfer from the solar array to the loads. The excellent dynamic regulation and low output impedance of the power system virtually eliminated the problem of subsystem interactions on the power bus due to conducted interference from load current fluctuations. The performance of the power system continues to be excellent. The solar array degradation (18.5 percent) was less than the specified 20 percent in two years in spite of extreme cycling from -160 C to 60 C. A unique battery cycling regime of discharges varying from 5 percent to 60 percent daily is being encountered. During the second year, noneclipse discharges have occurred twice a day to depths of 35 percent and 45 percent. Battery performance was good with only a small decrease in end-of-discharge voltage. A recent test to evaluate capacity gave 12.4 AH (83% of the nominal capacity of 15 AH) after over 1400 battery discharge cycles. A small increase in the end-of-charge voltage has recently occurred necessitating a change in the charge regime to achieve full charge conditions.

42466 (N—77-32235) **Mathematical simulation of power conditioning systems. Volume 1. Simulation of elementary units. Report on simulation methodology. Final report.** Prajoux, R.; Mazankine, J.; Ippolito, J.C. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes). 20 Jul 1976. Contract ESTEC-2299/74-AK. 97p. (LAAS-PUBL—1453(Vol.1); ESA-CR(P)—949(Vol.1)). NTIS PC A05/MF A01.

Methods and algorithms used for the simulation of elementary power conditioning units buck, boost, and buck-boost, as well as shunt PWM are described. Definitions are given of similar converters and reduced parameters. The various parts of the simulation to be carried out are dealt with: local stability, corrective network, measurements of input-output impedance, and global stability. A simulation example is given.

42467 (N—77-32236) **Mathematical simulation of power conditioning systems. Volume 2. Simulation of elementary units. Implementation of hybrid simulation system. Final report.** (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes). 20 Jul 1976. Contract ESTEC-2299/74-AK. 117p. (LAAS-PUBL—1453(Vol.2); ESA-CR(P)—949(Vol.2)). NTIS PC A06/MF A01.

The analog and numerical implementation of the hybrid simulation system for elementary power conditioning units buck, boost, and buck-boost is described, based on algorithms developed. The validity of the results is checked by means of numerical programs (CMSP 360). The analog and numerical implementation of the hybrid simulation for the shunt PWM elementary unit is also described.

42468 (N—77-32237) **Mathematical simulation of power conditioning systems. Volume 3. Simulation of elementary units. Results for boost, buck, buck-boost, shunt PWM. Final report.** Prajoux, R.; Mazankine, J. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes). 20 Jul 1976. Contract ESTEC-2299/74-AK. 323p. (LAAS-PUBL—1453(Vol.3); ESA-CR(P)—949(Vol.3)). NTIS PC A14/MF A01.

Results are presented of the hybrid simulation of elementary power conditioning units buck, boost, buck-boost and shunt PWM. For boost, buck and buck-boost, two operational modes were investigated: continuous and discontinuous conduction. Continuous conduction leads to bad performance of the basic unit and to a complicated correction network independent of current operating point, whereas discontinuous conduction provides for normal performance and a simple correction network, but dependence on current operating point. The shunt PWM behaves as a first order system since the solar array and switches are equivalent to a current source of a given value producing pulses on the output capacitor. The discontinuous conduction case applies also to the shunt PWM, except that its performance varies little with output current.

42469 (N—77-32238) **Mathematical simulation of power conditioning systems. Volume 4. Systems simulation: regulated bus, ac distribution, MPPT system. Final report.** Prajoux, R.; Mazankine, J. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes). 20 Jul 1976. Contract ESTEC-2299/74-AK. 244p. (LAAS-PUBL—1453(Vol.4); ESA-CR(P)—949(Vol.4)). NTIS PC A11/MF A01.

Systems simulations are presented for the regulated bus concept, for the ac distribution system, and for the Maximum Power Point Tracking (MPPT) distribution system. Results show that the regulated bus system performs relatively well both for continuous and discontinuous conduction. Solutions are given to problems caused by the battery charger. The ac distribution system is found to work correctly. The MPPT system is shown to have a slow response to voltage variations, and a modification is proposed.

42470 (N—77-32239) **Mathematical simulation of power conditioning systems. Volume 5. OTS power supply simulation. Final report.** Prajoux, R.; Mazankine, J.; Gouyon, J.P.; Chausson, P. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes). 7 Sep 1976. Contract ESTEC-2299/74-AK. 124p. (LAAS-PUBL—1453(Vol.5); ESA-CR(P)—949(Vol.5)). NTIS PC A06/MF A01.

The complete OTS power supply system was studied by simulation using the continuous system modeling program. The power supply system is of the regulated bus type, with a solar array subdivided into eight subpanels switched by a digital shunt. A separate simulation of this shunt is presented. The overall operation of the OTS power supply was found to be satisfactory.

42471 (N—77-32594) **An initial comparative assessment of orbital and terrestrial central power systems. Final report.** Caputo, R. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 15 Mar 1977. Contract NAS7-100. 158p. (NASA-CR—155042; JPL-PUBL—77-44). NTIS PC A08/MF A01.

A silicon photovoltaic orbital power system, which is constructed from an earth source of materials, is compared to likely terrestrial (fossil, nuclear, and solar) approaches to central power generation around the year 2000. A total social framework is used that considers not only the projection of commercial economics (direct or in internal costs), but also considers external impacts such as research and development investment, health impacts, resource requirements, environment effects, and other social costs.

42472 (N—78-10559) **Solar power satellite concept evaluation. Volume 1: summary. Progress report, Jul 1976—Jun 1977.** (National Aeronautics and Space Administration, Houston, Tex. (USA). Lyndon B. Johnson Space Center). Jun 1977. 130p. (NASA-TM—74820;JSC—12973-V-1). NTIS PC A07/MF A01.

A program was developed to determine the technical feasibility of a satellite solar power station. The space construction, maintenance, and transport systems are discussed. Environmental factors, in addition to manufacturing, natural resources, and energy were considered. Cost estimates and alternative systems are outlined.

42473 (ALO—2744-13(Vol.3)(Pt.1)) **Conceptual design and systems analysis of photovoltaic power systems. Volume III(1). Technology.** Pittman, P.F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). May 1977. Contract EY-76-C-04-2744. 571p. Dep. NTIS, PC A24/MF A01.

Conceptual designs were made and analyses were performed on three types of solar photovoltaic power systems. Included were Residential (1 to 10 kW), Intermediate (0.1 to 10 MW), and Central (50 to 1000 MW) Power Systems to be installed in the 1985 to 2000 time period. Subsystem technology presented here includes: insolation, concentration, silicon solar cell modules, CdS solar cell module, array structure, battery energy storage, power conditioning, residential power system architectural designs, intermediate power system structural design, and central power system facilities and site survey.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 42454, 42613

CENTRAL RECEIVER

42474 (EPRI-ER—652) **Solar-thermal conversion to electricity utilizing a central receiver, open-cycle, gas turbine design. Final report.** Grosskreutz, J.C. (Black and Veatch Consulting Engineers, Kansas City, Mo. (USA)). Mar 1978. 226p. Dep. NTIS, PC A11/MF A01.

A program to develop a solar/electric power plant which utilizes an open cycle gas turbine as the prime mover is discussed. A conceptual design for a commercial-scale plant, with a nominal rating of 60 MWe, was prepared. The characteristics of that baseline design, which employs an elevated central receiver surrounded by a field of heliostats, are presented. The turbine is a General Electric MS 7001R, and is located near the top of a 213 M (700 ft) tower. There are four receiver cavities, located at the top of that tower, each facing one quadrant of the heliostat field. That heliostat field contains about seven thousand heliostats, each with a reflecting surface area of 37.2 M^2 (400 ft^2). Energy storage, both buffer and long-term, is provided by fossil fuels. The fuel, either oil or gas, is burned in combustors which are in a parallel arrangement with the solar receivers. The turbine inlet gas temperature is 982 to 1066°C (1800 to 1950°F). Because these temperatures preclude the use of any available metal for the heat transfer surface, ceramics are employed. Experiments verified the suitability of silicon carbide for an application of this type and also verified the analytic methodology which had been used in the receiver design activities. Next is the design, fabrication, and testing of a bench model solar receiver, employing silicon carbide tubes. Preliminary estimates of the physical and operating characteristics of such a bench model were developed.

DISTRIBUTED COLLECTOR

42475 **Solar energy collection system.** Selcuk, M.K. (to National Aeronautics and Space Administration). US Patent 4,044,753. 30 Aug 1977. Filed date 28 Apr 1976. 8p.

An improved solar energy collection system, having enhanced energy collection and conversion capabilities, is delineated. The system is characterized by a plurality of receivers suspended above a heliostat field comprising a multiplicity of reflector surfaces, each being adapted to direct a concentrated beam of solar energy to illuminate a target surface for a given receiver. A magnitude of efficiency, suitable for effectively competing with systems employed in collecting and converting energy extracted from fossil fuels, is indicated.

TOTAL ENERGY AND HYBRID SYSTEMS

42476 (SAND—78-0109) **Solar total energy project. Semiannual report, April—September 1977.** Gerwin, H.J.; Kinoshita, G.S. (eds.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 105p. Dep. NTIS, PC A06/MF A01.

Activities of the Sandia Laboratories Solar Total Energy Project from April—September 1977 are described. Highlights, descriptions of the test facilities, results of subsystems and module tests, market studies, systems analyses, and large-scale experiments status reports are summarized.

42477 (SAND—78-0396) **Solar Total Energy Test Facility project test summary report: Rankine cycle Energy Conversion Subsystem.** Abbin, J.P. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

The Rankine cycle thermal energy conversion subsystem is described and results of tests run on the unit from December 1975 to November 1977 are summarized. The purpose of the tests was to evaluate subsystem performance and to determine its operational characteristics under input/output conditions imposed by the rest of the solar total energy system.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 43147

42478 (ANL-OTEC—78-1) **Analysis of heat transfer in horizontal tube falling film evaporators.** Lorenz, J.J.; Yung, D. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 42p. Dep. NTIS, PC A03/MF A01.

A model of combined boiling and evaporation of liquid films on horizontal tubes was developed. Specifically, this work was directed toward developing a heat transfer model applicable to the design of horizontal tube falling film evaportors for OTEC. The heat transfer process is modelled as combined boiling and evaporation of the liquid film. In modelling the behavior of single tubes special account is taken of heat transfer in the initial thermal developing region of the film. Predictions were found to agree favorably with the published experimental data for boiling and evaporation of thin water films on single horizontal tubes. The predicted upper and lower limits of heat transfer for ammonia on a vertical bank of plain horizontal tubes are 5.4 kW/m^2-K and 3.1 kW/m^2-K, respectively. The upper limit will be approached when the influence of between-tube evaporation and turbulence created by the liquid falling from one tube to the next are important. For an OTEC evaporator with plain tubes, the upper and lower limits of the overall U are 2.33 kW/m^2-K and 1.82 kW/m^2-K, respectively. With ammonia-side boiling enhancement, the overall U can be increased to about 3.8 kW/m^2-K.

42479 (CONF-780236—1) **OTEC physical and climatic environmental impacts: an overview of modeling efforts and needs.** Allender, J.H.; Ditmars, J.D.; Paddock, R.A.; Saunders, K.D. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From 5. OETC conference; Miami, FL, USA (20 Feb 1978).

The present overview of studies of the effects of ocean thermal energy conversion (OTEC) plant operation on the physical environment of the ocean includes a review of the pertinent results of past and contemporary model efforts in terms of their implications for OTEC development and suggestions for future research consistent with OTEC timetables. Particular consideration is given to the areas of utilization of the thermal resource, effects of a single OTEC plant, and aggregate effects of many OTEC plants. These potential effects include modification of the local temperature, salinity, and nutrient distributions, induced changes in mixed-layer depths and sea-surface temperatures, and dispersal of biocides or working fluids (due to leaks). Investigation of several early baseline OTEC designs indicates that the fractional net power losses are equal to about 2.4 times the fractional loss in thermal resource. Power cycle optimization appears to require the probability distribution of the thermal resource at a site. Preliminary studies of recirculation show that some design concepts may suffer 5 to 10% loss in net power output, but that design modifications may eliminate recirculation as a serious problem. Additional physical (hydraulic) model studies are required to put bounds on the recirculation potential of several generic designs in the near future. Review of model capabilities and limitations suggests that physical model studies also are needed to meet near-term OTEC needs for predictions of the complex near-field (1 to 3 km) effects of a single OTEC plant. Analytical and numerical models seem best-suited for predictions of the intermediate-field (2 to 10 km) effects. Evaluation of several generic designs in various possible sites requires the establishment of worst-case scenarios consistent with site data and with the needs of those assessing biological and ecological impacts.

42480 (DSE—2421-1) **Ocean thermal energy conversion mission analysis study. Phase I. Volume I. Final report.** (General Electric Co., Washington, D.C. (USA). Center for Advanced Studies). Jun 1977. Contract EX-76-C-01-2421. 171p. Dep. NTIS $8.00.

Several specific applications or missions for OTEC systems that appear to be commercially viable are examined and the questions of which locations and market place conditions are most favorable for OTEC are discussed. The question of how large a "subsidy" might be required to help OTEC over its early stages before independent commercial viability is achieved is addressed. In addition, possible institutional, industrial, and political barriers to OTEC implementation and deployment are identified and means of minimizing such barrier problems are discussed. The potential OTEC energy contribution within the U.S. energy system, and steps that should be taken to maximize that contribution are described.

42481 (TID—27953) **OTEC thermal resource report for Puerto Rico.** (Ocean Data Systems, Inc., Monterey, Calif. (USA)). Oct 1977. Contract EG-77-C-01-4028. 46p. Dep. NTIS, PC A03/MF A01.

Most probable monthly temperature profiles from surface to 1500-meter depths were developed for four one-degree latitude-longitude squares off Puerto Rico for Ocean Thermal Energy Conversion (OTEC) purposes. These ocean areas are characterized by remarkably homogeneous temperature conditions and small variability at all depths. In particular, a temperature differential (ΔT) in excess of 20°C exists between the surface layer and the 1000-meter depth the entire year in all of the areas. An inventory summary of the temperature observations available in the area, as well as overall bathymetric information are included. The monthly temperature data are provided in tabular form and as plots of ΔT versus depth for each latitude-longitude square.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 42510, 43139, 43143, 43144

42482 **Solar heating system component.** Bottum, E.W.; Rockwell, F.H. (to Refrigeration Research, Inc.). US Patent 4,044,948. 30 Aug 1977. Filed date 17 Oct 1975. 4p.

The solar heating system component combines a surge tank for a closed solar heat collecting system along with heat exchange means for transferring heat from the primary fluid in the solar heat collecting system to secondary fluid flowing in a secondary circuit which is used for a purpose such as to supply warm water, space heating or cooling and the like.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 42507, 42508, 42538, 42605, 43145, 43146

42483 (AD-A—047433) **Net energy analysis model for the evaluation of a solar heating, ventilation and air conditioning system.** Christ, M.A.; Hrapla, M.F. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Systems and Logistics). Sep 1977. 128p. (AFIT-LSSR—32-77B). NTIS PC A07/MF A01.

Thesis.

This research develops a feasible net energy analysis model from current net energy theory. The net energy model's purpose is to be utilized as an evaluation tool. Net energy analysis is based on the net energy model. Net energy analysis concerns itself with evaluating any system by its performance and interrelationship with the total environment in which the system operates. The model developed specifically addresses a heating, ventilation and air conditioning (HVAC) system. The net energy model was applied to two types of HVAC systems: one powered with conventional fuel sources and one powered with solar energy utilizing a conventional fuel back-up system. The model provided a realistic representation of both HVAC systems. An analysis was conducted on the two systems using data for a base exchange facility at Randolph AFB. The analysis included the use of three net energy analysis measures: net energy, yield ratio, and investment ratio. The results from the net energy analysis were compared to an economic analysis previously conducted to identify differences between the two evaluation methods.

42484 (BNL—24329) **Solar assisted heat pump system for year-round space conditioning.** Andrews, J.W.; Kush, E.A.; Metz, P.D. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 12p. (CONF-780231—1). Dep. NTIS, MF A01.

From Utility rate structuring; Washington, DC, USA (28 Feb 1978).

Portions of document are illegible.

A research program which has as its goal the development of a cost-effective solar-assisted heat pump system is briefly discussed. This program will build upon the extensive past analysis of solar-assisted heat pump systems and extend consideration into two areas which have been identified as vital to making the system cost-effective. These new areas are special heat pumps and special collectors. A solar assisted heat pump system was modeled using the University of Wisconsin transient simulation computer program TRNSYS. Results of the simulation are presented and discussed. (WHK)

42485 (CONF-770140—, pp 90-92) **Building roof and wall collectors.** Hall, M.D. (Univ. of Illinois, Macomb). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

An approach to collecting and using solar energy is discussed which keeps collecting costs low by incorporating the collector as part of the building structure and by using low temperature solar energy on farmstead applications where it can easily be adopted as: livestock ventilation systems and crop drying.

42486 (CONF-780114—9) **Analysis and design of solar buildings using the CAL—ERDA computer programs.** Graven, R.M.; Hunn, B.D.; Roschke, M.A.; Rosenfeld, A.H.; Cumali, Z.O.; Lokmanhekim, M. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 6p. Dep. NTIS, MF A01.

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

Portions of document are illegible.

A new set of computer programs have been developed which are capable of rapid and detailed analysis of energy consumption in buildings. These computer programs allow an architect/engineer to study various design options including detailed computations of the thermal performance of solar collectors, heat storage apparatus, and conventional heating and cooling equipment. In order to allow a simplified manipulation of the many variables used to describe a building, and to allow users the widest versatility in the design of solar buildings, a new user-oriented computer input language, called BDL, a Building Design Language, has been developed. This language is used to describe each component of a building, to analyze the input commands, and to notify the user of possible mistakes. BDL also controls data retrieval from a large set of libraries containing information on building components, materials, and operation schedules. It is also used to control the operation of the four primary computational programs which simulate the building LOADS, its Heating, Ventilating, and Air Conditioning (HVAC) SYSTEMS, the PLANT and solar equipment, and to compute ECONOMIC parameters.

42487 (COO—2868-4) **Performance comparison between air and liquid residential solar heating systems.** Karaki, S.; Duff, W.S.; Loef, G.O.G. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Jan 1978. Contract EY-76-S-02-2868. 20p. Dep. NTIS, PC A02/MF A01.

Comparisons of system performance for the flat plate liquid-heating system in CSU Solar House I, the evacuated-tube collector system in Solar House I, and the flat plate air-heating system in CSU Solar House II are described for selected months of the 1976 and 1977 heating seasons. Only space and domestic water heating data are compared. The flat plate air- and liquid-heating collectors operating with complete heating systems have nearly equal efficiencies when based upon solar flux while the collector fluids are flowing, but approximately 40% more energy is collected during a heating season with the air-heating system because the air system operates over a longer period of the day. On the basis of short-term data, the evacuated tube collector array on Solar House I is about 27% more efficient than the flat plate air-heating collector array on Solar House II based on gross roof area occupied by the collectors and manifolds.

42488 (COO—4577-1) **Hybrid photovoltaic/thermal solar energy system.** Kern, E.C. Jr.; Russell, M.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 27 Mar 1978. Contract EG-77-S-02-4577. 39p. Dep. NTIS, PC A03/MF A01.

Heating and cooling systems that use hybrid solar energy collectors (combination photovoltaic-thermal) have the potential for considerable energy savings, particularly when the system includes a heat pump. Economic evaluations show that photovoltaic systems are potentially most economical, but results depend critically on future collector costs as well as energy prices. Results are based on a specially developed computer program that predicted the total auxiliary energy required for five different solar heating/cooling systems. Performance calculations for a modeled residence and small office building were made using meteorological data from four geographic locations. Annual system costs were also calculated.

42489 (LA-UR—78-677) **Data acquisition and monitoring system for Los Alamos National Security and Resources Study Center.** Trump, M.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 6p. (CONF-780432—2). Dep. NTIS, PC A02/MF A01.

From Conference on performance monitoring techniques for evaluation of solar heating and cooling systems; Washington, DC, USA (3 Apr 1978).

The National Security and Resources Study Center, a modern, three level building containing 5574 m^2 of temperature controlled space and an integral solar energy heating and cooling system is in operation at Los Alamos, New Mexico. The instrumentation system used to measure the energy production (solar energy system) and consumption (HVAC system) in all the building operating modes is described. Included are descriptions of the sensors (temperature, mass flow, power, etc.) and the data acquisition system.

42490 (LA-UR—78-754) **On-line performance calculations for the Los Alamos National Security and Resources Study Center.** Murray, H.S.; Hedstrom, J.C. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-36. 8p. (CONF-780432—3). Dep. NTIS, PC A02/MF A01.

From Conference on performance monitoring techniques for evaluation of solar heating and cooling systems; Washington, DC, USA (3 Apr 1978).

The National Security and Resources Study Center at Los Alamos, New Mexico, has been heavily instrumented to permit monitoring of the performance of the solar heating and cooling system. The monitoring system includes a computer, which provides the capability for doing real-time engineering calculations. This capability permits data compression and allows the researcher to interact with the system and to see immediately the results of changing the system parameters.

42491 (LA-UR—78-965) **Hybrid passive/active solar house: first year performance of the Hunn residence.** Hunn, B.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 6p. (CONF-780337—4). Dep. NTIS, PC A02/MF A01.

From 2. national passive solar conference; Philadelphia, PA, USA (15 Mar 1978).

Portions of document are illegible.

The solar heating system consists of a Trombe wall constructed of 1-ft-thick slump block and a rock bed storage system that can be charged by blowing air through the Trombe wall air space and into the rock bed. Operating results of the system, which is being monitored by the Los Alamos Scientific Laboratory (LASL), are reported for just over the first year of operation (1977 and part of 1978). In addition, occupant observations and conclusions are presented. Energy consumption records for 1977 indicate that approximately 60% of the space heating load was provided by solar energy.

42492 (LLL/M—087) **Plant engineers solar energy handbook. Southern California region.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1978. Contract W-7405-ENG-48. 335p. Dep. NTIS, PC A15/MF A01.

Portions of document are illegible.

Discussed in order after the introduction are solar components and systems (collectors, storage, service hot water systems, space heating with liquid and air systems, space cooling, heat pumps and controls); computer programs for system optimization; local solar and weather data; a description of buildings and plants in Southern California applying solar technology; current Federal and California solar legislation; standards, codes and performance testing information; a listing of manufacturers, distributors, and professional services available in Southern California region; and information access. Finally, solar design check lists for those engineers who wish to design their own systems. The program for the Solar Workshop for the Plant Engineer, March 30, 1978, Los Angeles, California is included. (MHR)

42493 (NP—23162) **Continuation study of the potential for solar heating of buildings in Canada.** Hollands, K.G.T.; Orgill, J.F. (Waterloo Univ., Ontario (Canada)). Aug 1977. 44p. Dep. NTIS, PC A03/MF A01.

The printed output from WATSUN, a computer program for simulating the performance of a solar heating system, was revised to provide more information to the user. A computer subroutine was added to WATSUN to model a solar heating system with two liquid storage subsystems. WATSUN was compared with existing simplified design methods. (MHR)

42494 **Environmentally heated and cooled building.** Granger, F.R.; Granger, M.G. US Patent 4,051,999. 4 Oct 1977. Filed date 5 Apr 1976. 8p.

A solar heated building is described including a thermal collector means which is carried in the attic of the building for absorbing energy and heating the air within the attic. Duct means are connected between the attic and a thermal storage chamber carried below the bottom floor of the building. The thermal storage includes a rock bed extending substantially under the entire area of the house with the joists which support the bottom floor of the building resting on top of the thermal storage chamber. Registers are carried in the floor extending between the space provided between a pair of adjacent joists so that conditioned air can be fed between the joists to the registers for either heating or cooling the house. Control means which are activated by strategically located sensors are utilized for opening and closing dampers for controlling the flow of air through the building.

42495 **Complete solar house.** Cassiday, B. New York; Dodd, Mead and Co. (1977). 219p. $6.27.

The following subjects are included: an introduction to solar energy; a history of pioneers in the field; a description and explanation of solar collector, storage units, and distribution systems; a look at a typical solar hot-water system, a swimming-pool heating system, an air-conditioning system, and a heating/cooling system. In addition, retrofitting is explored; the homeowner is told how to prepare his house for solar heat; and the problem of installation costs is explored. How much sunshine can be expected every month of the year in various geographical locations is shown. A list of companies manufacturing solar energy components is included in an appendix. (MHR)

42496 **Solar home heating in Canada: problems and prospects.** Foster, H.D.; Sewell, W.R.D. Ottawa; Dept. of Fisheries and Environment (1977). 237p.

This study of the barriers and incentives to the adoption of solar home heating in Canada is also a study of the diffusion of innovation. The process of change and the roles of the participants are discussed at length. Recommendations, a solar energy questionnaire, and a resume in French are included. (MHR)

42497 **Building and using our sun-heated greenhouse. Grow vegetables all year-round.** Nearing, H.; Nearing, S. Charlotte, VT; Garden Way Associates, Inc. (1977). 153p. $5.95.

Experience with unheated greenhouses in Maine and Vermont is described from the viewpoint of vegetarian, homesteading organic gardeners. The necessity of extending the growing season in the north in order to have fresh vegetables year round is discussed. Locating, building, and maintaining soil and growing conditions in the greenhouse are included. Plants for each season in the greenhouse are discussed. (MHR)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 42485, 42532, 42533

42498 (CONF-770140—) **Solar grain drying conference proceedings.** Shove, G.C. (ed.). (Illinois Univ., Urbana (USA)). Oct 1977. 286p. Dep. NTIS, PC A10/MF A01.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

Thirty papers are included. A separate abstract was prepared for each paper. (MHR)

42499 (CONF-770140—, pp 1-2) **Agricultural programs in solar energy.** Altman, L.B. (Agricultural Research Service, Beltsville, MD). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The solar energy agricultural program was subdivided into five research areas: solar grain drying; solar drying of peanuts, forages, and tobacco; use of solar energy in livestock production; solar heating and cooling of greenhouses and rural residences; and solar energy in food processing. (MHR)

42500 (CONF-770140—, pp 3-9) **Overview of solar grain drying research: field tests.** Foster, G.H. (Agriculture Research Service, Manhattan, KS). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Eighteen solar-assisted drying tests were conducted with the 1974 crop at eight locations in the North Central region of the United States. One test was with soybeans, two were with grain sorghum, and 15 were with shelled corn. The tests were typical of low-temperature, in-storage drying, although in one test conditions were similar to those of batch-in-bin drying. Tests were continued at six locations in 1975 and eight locations in 1976. All of the grain in the solar drying tests was successfully dried to safe storage moisture levels without significant spoilage. However, in some tests supplemental electric heat was used in addition to solar energy. Drying rates with solar systems were adequate for preventing spoilage and were in the range of those used for typical low-temperature drying—faster than with natural air drying and usually a little slower than with typical low-temperature heat drying systems. Final grain moisture levels were lower in solar tests than in natural-air tests and generally higher than in tests with continuous heat added.

42501 (CONF-770140—, pp 10-25) **Simulation of solar corn drying in the Midwest.** Peart, R.M. (Purdue Univ., W. Lafayette, IN). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The results of a one-year project by five groups working in this area are reported. The simulations use models that are basically of the equilibrium type, the thin layer drying equation, or a combination. The results of the computer simulation are compared with the data from an actual bin. (MHR)

42502 (CONF-770140—, pp 78-89) **Bin sidewall collectors.** Peterson, W.H. (South Dakota State Univ., Brookings). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Experience and data from making the walls of a drying bin into solar collectors are reviewed. Both bare plate and covered collectors were used. (MHR)

42503 (CONF-770140—, pp 93-97) **Grain storage collector combinations.** Lipper, R.; Welker, J.C. (Kansas State Univ., Manhattan). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The concept of using solar energy as supplemental heat for grain drying is attractive since a uniform or controlled heat supply is not essential and low air temperature increases can be tolerated.

With low temperature increases, reasonable efficiencies can be obtained from relatively simple, low-cost solar collectors. At Kansas State University, it was demonstrated as early as 1960 that adding a solar collector to a natural air grain drying system can reduce drying time and electric energy required for fan power. However, it was concluded that the fundamental shortcomings of attempting to use solar energy simply as a direct substitute for fuel burning or electric heaters in conventional deep-bed drying systems would preclude their widespread adoption by farmers, at least in Kansas. Nothing has been learned up to this time to alter that conclusion. An experiment is reported here using an air-inflated plastic bag as shallow-bed storage bin and collector.

42504 (CONF-770140—, pp 100-103) **Focusing solar energy collectors-sun tracking type.** Parker, B.F.; Loewer, O.J. Jr.; White, G.M. (Univ. of Kentucky, Lexington). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

In the Southeast, grain drying without risk of spoilage requires a faster rate of drying than in the Midwest due to higher ambient temperatures during the harvest season. Therefore, the Southeast can not depend upon low temperature drying methods such as those in the upper Midwest. The focusing solar collector is unique in that it can collect solar energy at temperatures of 250F or more; thus, it is technically possible to use solar energy to heat air for high temperature grain drying. A simple examination of sun-tracking types of focusing collectors shows that with reasonable size units the energy collected during the grain harvesting season is insufficient for drying large quantities of grain. Therefore, it is essential to provide a heat storage unit. Heating the storage medium to a relatively high temperature will significantly reduce the quantity of storage volume required to store a given quantity of heat.

42505 (CONF-770140—, pp 121-148) **Where does solar grain drying fit.** Thompson, T.L.; Pierce, R.O. (Univ. of Nebraska, Lincoln). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

It was concluded that selection of an airflow rate is the most important factor in designing a low temperature drying system. A simulation model was used to determine the minimum airflow rates required for low temperature drying in the North Central Region of the United States. Ten years of actual weather data were used in the simulation model for one location in each of the North Central states. The results are shown. (MHR)

42506 (CONF-770140—, pp 150-151) **Experiences with solar grain drying.** Ponder, D.A. (Cash Grain Farmer, Tuscola, IL). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Experiences with stirring machines then switching to low temperature drying and finally making a solar collector of the south side of the grain bin for additional heat are described. (MHR)

42507 (CONF-770140—, pp 152-159) **Experiences with solar grain drying and shop heating.** Sims, R. (Sims' Farms, Liberty, IL). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

A water-antifreeze mixture is circulated through plastic pipe on the roof and through iron pipe embedded in the concrete floor of the shop in one end of the machine shed. The machine shedroof is clear corrugated fiberglass over black fiberboard. Air is pulled the full length of the building beneath the fiberglass roofing from west to east where it is collected and pulled down the wall to a 3 ft diameter steel culvert that carries it to the grain bins. Air may be pulled through the roof collector to heat the shop also. (MHR)

42508 (CONF-770140—, pp 160-161) **Experiences with solar grain drying and livestock shelter heating.** Lasswell, D. Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The roof of the swine building is used as a bare plate solar collector. The solar air chamber was created by laying 8/10 inch urethane foam insulation boards running the length of the building. The solar heated air is used to ventilate the swine building or directed to grain drying bins. (MHR)

42509 (CONF-770140—, pp 162-178) **Potential application of solar energy to combination (high-low) temperature drying.** Morey, R.V.; Cloud, H.A. (Univ. of Minnesota, St. Paul). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Information is presented on energy use for combination drying and the reduction in energy required in the low-temperature drying phase by using supplemental solar heat in addition to ambient air is evaluated. These evaluations are made for three locations: St. Cloud, Minnesota; Des Moines, Iowa; and Indianapolis, Indiana. The system is described and its performance analyzed. (MHR)

42510 (CONF-770140—, pp 179-192) **Multiple use solar heat collection and storage system for grain drying.** Hansen, R.W.; Smith, C.C. (Colorado State Univ., Fort Collins). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

This study on the utilization of solar energy was based on spreading the investment for equipment over several applications since it is common to each use. If the same equipment can be used for applications occurring during different times of the year, the cost effectiveness is improved. By determining the requirements of various applications, a multiple use system can be designed based on a reasonably well balanced load the year-round. The layout of an agricultural production system that might be developed around a central solar heat collection facility is illustrated schematically.

42511 (CONF-770140—, pp 193-199) **Bin-drying with stirring: rice.** Calderwood, D.L. (Dept. of Agriculture, Beaumont, TX). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Solar heat aided deep-bed rice drying by reducing drying time and electrical energy consumption for fan operation compared with unheated air-drying. A small reduction in milling yield was noted in rice samples from dryers using solar heated air compared with unheated air-dried samples. The use of a stirring auger did not change the amount of milling yield reduction. The range of moisture contents of rice samples taken as a dryer was unloaded was about the same for samples from a dryer equipped with a stirring auger and solar collector as for samples from a dryer with a solar collector, but without a stirring auger. Stirring augers provided uniform moisture contents of rice at different locations in dryers and eliminated well defined drying zones.

42512 (CONF-770140—, pp 200-203) **Stirring of corn for solar heated in-bin drying.** Peart, R.M. (Purdue Univ., Lafayette, IN). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

A vertical stirring auger was used in 1975 and 1976 in solar drying tests with corn in an 18-foot diameter bin with grain depths of about 10 feet. The effect of stirring on moisture distribution, air flow, and allowable drying time are discussed. (MHR)

42513 (CONF-770140—, pp 204-211) **Solar energy: heat pump low temperature grain drying.** Morrison, D.W.; Shove, G.C. (Univ. of Illinois, Urbana). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The solar collector—heat pump combination effectively reduced the electrical energy requirements for the low temperature drying of shelled corn from the accepted value of 8.51 kWh/m^3/point of moisture removed (0.3 kWh/bu/point of moisture removed) (Shove, 1976). The 8.92 m^2 (96 ft^2) portable collector used in 1975 was too small to be effectively used on a 211 m^3 (6,000 bu) bin equipped with a 7.46 kW (10 hp) fan; thus the energy reduction was small for the 1975 investigation. But the 1976 collectors along with the heat pump provided a sufficient amount of heat energy to almost halve the electrical consumption required for low temperature drying.

42514 (CONF-770140—, pp 212-221) **Solar-assisted heat pump for low-temperature corn drying.** Anderson, M.E.; Bern, C.J. (Iowa State Univ., Ames). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Heat pumps are being used to heat drying air in low-temperature corn-drying systems. Utilization of a solar energy input can, under certain conditions, improve the energy utilization efficiency of the heat pump. Field tests of a low-temperature corn-drying system using a solar-assisted heat pump are reported here. The solar-assisted-heat-pump system performed according to theory. The solar collectors increased the COP (and thus the output) of the heat pump at a given outside air temperature. The solar-assisted heat pump

system required less electrical energy to dry the grain than did the control bin. This also means that the electrical bill for grain dried with this solar-assisted-heat-pump system would be less than the bill for the same grain dried in a system like the control bin. Substantially less electrical energy was required in the solar-assisted-heat-pump system to remove a unit mass of water from the grain.

42515 (CONF-770140—, pp 233-249) **Thermal storage in grain drying.** Eckhoff, S.R.; Okos, M.R. (Purdue Univ., W. Lafayette, IN). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

There is a need for the utilization of thermal storage with solar supplemented and natural air grain drying. Thermal storage can increase the confidence of such low temperature drying procedures to satisfactorily replace the existing high temperature drying techniques. Focus should be given to the development of long term storage systems which are low in cost and fit the requirements for grain drying. Particular attention should be given to the use of an encased saturated soil thermal storage system because of the inexpensive materials needed for construction. Research is needed which will give experimental and analytical results of the feasibility of such a system for use with grain drying.

42516 (CONF-770140—, pp 250-254) **Heat storage in phase change materials for solar grain drying.** MacCracken, C.D. (Calmac Manufacturing Corp., Englewood, NJ). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

A grid of small flexible plastic tubes rolled into a spiral and put into a cylindrical plastic tank filled with phase change materials is discussed for use in solar grain drying. (MHR)

42517 (CONF-770140—, pp 255-256) **Solar drying of wheat.** Barrett, J.R. Jr.; Stevens, J.B. (Purdue Univ., West Lafayette, IN). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Research was conducted to compare in-bin drying of wheat using solar heated air with drying using unheated air. Wheat was combined by cooperating farmers in late June 1976 to fill two 18-foot diameter bins with approximately 1700 bu. of 21-23% grain each. Depth was limited to about 7 feet, which is less than for drying of corn. This reduction is caused by the greater resistance of wheat to air flow. The fans supplied 2-2.5 cfm air flow per bushel. One bin was dried with solar heated air from 2 horizontal suspended-plate inflated plastic (pvc) collectors and the other with unheated air. The maximum increase of temperature of heated air was 29°F. Field dry-down, grain quality, and harvest, environmental, and in-bin drying conditions were monitored.

42518 (CONF-770140—, pp 257-258) **Experience with a "bin-bib" solar collector.** Lipper, R.; Welker, J.C. (Kansas State Univ., Manhattan). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

A type of bin-wall solar collector was tried which was an enclosed envelope with its front side made from nylon reinforced clear plastic film and its back side from black film. Experiences and problems are mentioned briefly. (MHR)

42519 (CONF-770140—, pp 259-282) **Feasibility study of in-bin corn drying in Missouri using solar energy.** Bakker-Arkema, F.W. (Michigan State Univ., East Lansing); Brooker, D.B.; Roth, M.G. Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The feasibility of in-bin corn drying using solar energy was investigated by conducting an in-depth simulation study in Missouri. The main conclusions are that in Missouri: Solar drying and low temperature (natural air) drying are equally feasible at the same airflow and initial moisture content values. Solar drying reduces the hours of fan operation. However, the KWH or BTU savings are minimal. Energy savings from solar corn drying are not sufficient to justify the use of solar collectors.

42520 (NTIS/PS—78/0005) **Solar crop drying (citations from the Engineering Index Data Base). Report for 1970-Dec 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 43p. NTIS PC N01/MF N01.

Abstracts from worldwide literature discuss design and performance of solar collectors for crop drying applications, crop drying in bins with solar heated air, energy requirements for crop drying, and solar dryers supplemented with auxiliary heating systems. (Contains 36 abstracts)

42521 (ORO—5121-1) **Application of solar energy to industrial drying or dehydration processes. Final report.** (Midwest Research Inst., Kansas City, Mo. (USA)). 17 Mar 1977. Contract EY-76-C-05-5121. 149p. Dep. NTIS, PC A07/MF A01.

The detailed engineering design of a solar array applied to the preheating of both combustion and excess air for a rotary alfalfa dehydrator is reported. The alfalfa dehydration process and the design parameters of rotary dehydrator are described, including the energy consumed by the plant, the airflow requirements of the dehydrator, and the interface between the dehydrator and the solar array. The design of the collector array is discussed, including the solar collector selection, the calculation of collector areas, and the simulations of the system performance. Discussions of the detailed engineering drawings and specifications of the array construction, duct work, air handling equipment, system controls, data monitoring and acquisition systems, and the results of the contractors' bids are presented. An economic analysis is given of the solar system using the Lawrence Livermore Laboratory format. The impact of the solar system on the process energy requirements and on the operation of the plant are discussed. Additional information and supporting calculations for material covered in the text of the report are contained in the appendices. (MHR)

42522 (ORO—5123-1) **Research on the application of solar energy to industrial drying or dehydration processes. Final Phase report.** (California Polytechnic State Univ., San Luis Obispo (USA); TRW Systems and Energy, Redondo Beach, Calif. (USA)). Mar 1977. Contract EY-76-C-05-5123. 234p. Dep. NTIS, PC A11/MF A01.

The dehydration operation is described. The system design and its economic analysis are discussed. The system analysis covers the solar collectors, fan and ducting selection, rock storage design, heat recovery, control system, system simulation, and the monitoring system. The construction costs are discussed thoroughly. The construction design is presented including engineering drawings. (MHR)

42523 (ORO—5157-1) **Analysis and development of a solar energy regenerated desiccant crop drying facility: Phase I. Final report, July 1976—April 1977.** Ko, S.M.; Merrifield, D.V.; Fletcher, J.W. (Lockheed Missiles and Space Co., Inc., Huntsville, Ala. (USA). Research and Engineering Center). Apr 1977. Contract EY-76-C-05-5157. 137p. Dep. NTIS, PC A07/MF A01.

The results of a study to verify the technical feasibility of the regenerated desiccant crop drying concept, characterize its performance, investigate design requirements, and define a pilot facility for further evaluating the operational and energy-conservative characteristics of the drying system are documented. The pilot facility defined in this study will be a use R and D tool of sufficient size to permit a meaningful evaluation of the system and to provide the necessary criteria for development of full-scale systems. The principal finding of the study is that the regenerated desiccant crop drying concept is technically feasible and has the capability to achieve a drying efficiency of approximately twice that of conventional crop drying systems. When using a fossil fuel energy source, energy savings will be approximately 40 to 50%. With solar energy input, the total fossil fuel savings could be 70 to 90%. The economic feasibility of the system appears promising. As with other new energy conserving systems that are presently capital-intensive, the economic viability of the system will be dependent on future capital cost reductions, on the future price of fossil fuels, and on the specific application of the system. Regarding system applications, it was concluded that the regenerated desiccant drying system, with or without the use of solar energy, will be economically best suited for a large central processing application, where it can receive a maximum amount of use and will benefit from economy-of-scale cost considerations. The basic study recommendations are: (1) additional R and D activities should be conducted to identify and evaluate means for achieving system cost reductions, and (2) the Mobile Pilot Facility program should be initiated.

WATER HEATING

REFER ALSO TO CITATION(S) 42492, 42495

42524 (CONF-780114—6) **Double-exposure collector system for solar heating applications.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, Pa. (USA)). 1978. Contract EG-77-G-04-4089. 5p. Dep. NTIS, PC A02/MF A01.

From International Solar Energy Congress; New Delhi, India (16 Jan 1978).

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks mounted at the latitude angle for Philadelphia of 40° from the horizontal and two double-

exposure collectors (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications. The performance of the DEC units relative to conventional collectors has been calculated.

42525 (HCP/15663—01) **New and retrofit solar hot water installations in Florida, January—June 1977.** (Florida Solar Energy Center, Cape Canaveral (USA)). Apr 1978. 25p. Dep. NTIS, PC A02/MF A01.

The purpose of this project was to ascertain the number of solar hot water installations in new buildings versus the number retrofitted to existing buildings in Florida during the January to June period of 1977. The methodology was to survey all installations started, in progress, or completed during that period. A by-product of the survey is a comprehensive list of manufacturers and another of distributors and installers in Florida. The survey excludes space heating and cooling and pool heating applications. However, the latter is being considered for a separate survey. Installations included are in the single-family and multi-family residential, commercial, industrial and public sectors. In the single-family residential sector, care has been taken to determine a new or retrofit breakdown, average square footage of collector per installation, average cost per square foot of collector in Florida, and subsequently, using F-CHART and system sizing programs developed at the Center, the fraction of load supplied by solar and its equivalent barrels of oil saved per year. In the multi-family residential, commercial, industrial and public sectors, specific information on each installation has been provided. This information includes new or retrofit, ownership, type of collector and manufacturer, square footage of installation, design percentage energy by solar, suxiliary fuel, system cost, and federal grants, if any.

OTHER

REFER ALSO TO CITATION(S) 42543

42526 (N—77-32589) **Installation in Dakar of a pump powered by solar cell pannels. Final report.** Naaijer, C.J. (Laboratoires d'Electronique et de Physique Appliquee (LEP), 75 - Paris (France)). Jun 1976. Contract DGRST-75-7-1302. 44p. NTIS PC A03.

The installation of a solar-powered water pumping system in Dakar (Franch Sahara) is described. The interrelation of the various constraints is detailed together with the reasons for choosing photovoltaic cells. The solar collector pump, engine, buffer battery, and control unit are discussed. The functional characteristics for the automation of the system is elaborated upon.

42527 (NTIS/PS—77/1161) **Solar water pumps (citations from the Engineering Index Data Base). Report for 1970-Nov 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 38p. NTIS PC N01/MF N01.

Design concepts and the technical and economic feasibility of using solar energy to pump water are discussed in abstracts from worldwide literature. Topic areas cover the use of solar heat actuated Rankine cycle engines and free cylinder Stirling engines for solar powered water pumps, pumps driven by photovoltaic modules, and application of solar pumps to irrigation and electric power generation. (Contains 31 abstracts)

42528 (NTIS/PS—78/0001) **Solar furnaces (citations from the Engineering Index Data Base). Report for 1970-Dec 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 51p. NTIS PC N01/MF N01.

Design, operation, and performance of solar furnaces are discussed in abstracts from worldwide literature. Topic areas include the thermodynamics and optics of operation, and the performance of the large solar furnace located at Odeillo (France). (Contains 43 abstracts)

42529 (NTIS/PS—78/0002) **Solar distillation (citations from the Engineering Index Data Base). Report for 1970-Dec 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 96p. NTIS PC N01/MF N01.

Feasibility, design, and construction of solar stills are discussed in abstracts of reports from worldwide literature. Most abstracts deal with the construction of solar stills for the desalination of sea water; a few abstracts pertain to thermodynamic analyses, agricultural uses, and providing potable water for isolated residences or small communities. Experience with the use of solar stills in various countries is covered. (Contains 89 abstracts)

42530 (NTIS/PS—78/0006) **Greenhouse design, construction, and operation (citations from the Engineering Index Data Base). Report for 1970-Dec 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 130p. NTIS PC N01/MF N01.

Thermal environment, construction materials, and structural integrity of greenhouses are discussed in abstracts from worldwide literature. Topic areas cover the use of plastics and glass in greenhouse construction, with emphasis on the use of plastics; heating with solar energy and waste heat; methods of reducing heat loss; and wind load and wind induced heat transfer studies. Abstracts on air supported greenhouses and combination greenhouse-solar distillation units are included. (Contains 123 abstracts)

42531 (UCID—17510(Rev.1)) **Solar technology applications: a survey of solar powered irrigation systems.** Newkirk, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Apr 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

Published information on solar powered irrigation systems is presented. Thermal solar systems, thermoelectric solar systems, and photovoltaic solar systems are included. A bibliography and survey of on-going work is presented. (WHK)

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 42429, 42430, 42453, 42487, 42524

42532 (CONF-770140—, pp 34-38) **Solar energy collectors for drying grain.** Shove, G.C. (Univ. of Illinois, Urbana). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

The following are briefly discussed: covered plate collectors, bare plate collectors, collectors incorporated into buildings, suspended plate collector, and collector efficiency. (MHR)

42533 (CONF-770140—, pp 50-55) **Solar collector performance.** Kline, G.L. (Iowa State Univ., Ames). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Solar energy collectors of various types were investigated for use in drying grain. The performance of 9 differnt solar collectros is reported.

42534 (CONF-770140—, pp 56-77) **Plastic film solar collectors for grain drying.** Keener, H.M.; Sabbah, M.A.; Meyer, G.E.; Roller, W.L. (Ohio Agricultural Research and Development Center, Wooster). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

In recent years considerable improvement has been achieved in the durability of plastic materials exposed to ultraviolet radiation. The experimental use of these materials has shown their potential for use in solar heat collectors. The characteristics of plastic film solar collectors and their potential for heating air in grain drying systems are discussed.

42535 (CONF-770140—, pp 104-120) **Non-tracking solar concentrators.** Hellickson, M.A. (South Dakota State Univ., Brookings). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

Information is presented on non-tracking solar concentrators. The types discussed and illustrated are: the ideal or Winston concentrator, variations of the ideal concentrator, the stationary sea-shell collector, stationary reflector tracking absorber, linear Fresnel lens, mirror-enhanced flat-plate collectors, an inflated cylinder,focusing collector, solar wings, and the SDSU solar energy-intensifier system. (MHR)

42536 (CONF-770140—, pp 222-232) **Solar pond collector and heat storage device.** Short, T.H.; Roller, W.L.; Badger, P.C. (Ohio Agricultural Research and Development Center, Wooster). Oct 1977.

From National solar grain drying conference; Champaign, IL, USA (11 Jan 1977).

In Solar grain drying conference proceedings.

A solar pond is being studied as a solar collector and potential storage system along with the appropriate equipment to move heat from the pond to a greenhouse. The pond was designed to meet all of the winter heat requirements of a 186 m^2 (2000 ft^2) three bedroom home or a 98 m^2 (1000 ft^2) greenhouse in Wooster, Ohio. This system could also be applicable for process heating such as grain drying.

42537 (GA-A—14595) **Solar collector subsystem program on the fixed mirror solar concentrator. Design and tests. Report of work performed September 30, 1976—February 28, 1977, following issuance of final report GA-A-14209 (Rev.).** Eggers, G.H.; Housman, J.J.; Openshaw, F.L.; Russell, J.L. Jr. (General Atomic Co., San Diego, Calif. (USA)). Aug 1977. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

The additional testing and design work performed is described in Phase II of the Solar Collector Field Subsystem Program on the Fixed Mirror Solar Concentrator (FMSC). The tests and test results achieved are summarized.

42538 (N—77-75716) **Inhibitor analysis for a solar heating and cooling system. Final report, January—December 1975.** Tabony, J.H.; Graham, I.; Cooper, B.; Combest, E.; Wells, H. (Southern Univ., Baton Rouge, La. (USA). Dept. of Mechanical Engineering). 1975. 30p. NTIS PC A03/MF A01.

This report is a study of potential corrosion inhibitors for the NASA solar heating and cooling system which uses aluminum solar panels. A study was conducted to determine which commercially available grades of inhibitors could be used. A test system and method for accurately simulating an actual solar heating and cooling system were developed. Corrosion tests were conducted. It was found that the best inhibitor tested reduced the corrosion rate of aluminum (panel material) by 95% and reduced the corrosion rate of steel (piping and reservoir material) by 85% from the corrosion rate that occurred when no inhibitor was used.

42539 (N—78-11366) **Microscopic examination of the behavior of non-conductive optical solar reflectors after electrical breakdown.** Minier, C.E. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Sep 1977. 26p. (ESA-TM—172). NTIS PC A03/MF A01.

Nine nonconductive optical solar reflectors (OSR) were subjected to microscopic examination after irradiation with low-energy electrons (15 to 20 keV). Defects were found and closely studied. Subsequently, attempts were made to create similar defects in the laboratory so that the process could be fully understood and an explanation for it provided. An OSR panel with a nonconductive adhesive presents risks of degradation which can be detrimental to the thermal equilibrium in a spacecraft. The use of conductive adhesives to avoid such hazards needs to be examined.

42540 (PB—275042) **Focusing solar collector development. Final report.** Rogers, W.E.; Borton, D.N.; Burr, A.A. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). 31 Jul 1977. 77p. NTIS PC A05/MF A01.

This report discusses design modifications and engineering tests on a dual tracking focusing solar collector concept. The 360 square foot concentrator was constructed to evaluate performance of a heliostat design and of receivers at its focus, as well as to ascertain characteristics of insolation at the site.

42541 (SAN—1084-77/1) **Transparent glass honeycomb structure for energy loss control. Progress report, April 1976—July 1977.** Buchberg, H.; Edwards, D.K.; Mackenzie, J.D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Aug 1977. Contract EY-76-G-03-1084. 56p. Dep. NTIS, PC A04/MF A01.

Equipment was successfully designed, constructed, and used to fabricate thin corrugated sheet glass continuously utilizing a hot-rolling technique. Approximately 150 thin glass sheets, 12 in. x 3 in. x 0.012 in., were corrugated and made available for testing in a single-glazed solar collector with a liquid-cooled, nonselective black absorber. The analysis and computer program developed for the calculation of solar and infrared radiative transfer through tubular honeycomb was reviewed and revised for application to parallel plate and sinusoidal sheet honeycombs. Outdoor performance tests included the measurement of the solar transmittance of the glass honeycombs with and without a coverglass, instantaneous quasi-steady state solar conversion efficiency and daily integrated efficiency of experimental collectors.

42542 (SAND—78-0554) **Thermal aging of electrodeposited black chrome.** Sowell, R.R.; Pettit, R.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 14p. Dep. NTIS, PC A02/MF A01.

Electrodeposited black chrome was selected as the most suitable selective coating for Sandia's Solar Total Energy Test Facility. In the initial studies, black chrome coatings exhibited little or no degradation in optical properties after 1000 hours at 350°C in air. After approximately two years in the facility, the visual appearance of some receiver tubes had changed. One tube was removed for examination and showed a decrease in solar absorptance from > or = to .94 to .85. Sputter-Auger-profiling and scanning electron microscopy studies to determine differences between stable and unstable coatings are described. A continuing study of the plating process variables to establish a process which consistently produces stable black chrome coatings is outlined. (WHK)

42543 (UCRL—52397) **Engineering feasibility of a 150-kW irrigation pumping plant using shallow solar ponds.** Platt, E.A.; Wood, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1978. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

The economics was analyzed of a field of shallow solar ponds that presumably supplies the heat for a Rankine cycle engine using refrigerant R-113 for the working fluid. When operating, the engine supplies 150 kW of shaft power, 125 kW of that is available for deep-well irrigation pumping. The system components have been chosen to produce the maximum net energy—April through October—per dollar of installation cost. Weather data are from Inyokern, California, 1962 records for most calculations. It was estimated that, for a private investor, the real internal rate of return for this installation would be positive only if in the forseeable future the cost of conventional energy were to inflate 8% faster than the cost of the commodities needed by the solar system. A 17% differential inflation rate would produce a 10% rate of return. Reduction in cost of the shallow solar ponds potentially could reduce the system installation cost by about 20%.

42544 **Solar heating pipe.** Hinson-Rider, G. US Patent 4,051,835. 4 Oct 1977. Filed date 17 Nov 1975. 2p.

A fluid carrying pipe is described having an integral transparent portion formed into a longitudinally extending cylindrical lens that focuses solar heat rays to a focal axis within the volume of the pipe. The pipe on the side opposite the lens has a heat ray absorbent coating for absorbing heat from light rays that pass through the focal axis.

42545 **Reinforced structural panel with integral solar energy collecting array and method of producing and assembling same.** Vandament, D.D. US Patent 4,051,833. 4 Oct 1977. Filed date 19 Nov 1975. 14p.

A composite reinforced structural panel includes upper and lower skin members with a flexible arched member arranged therebetween and secured in place by means of an adhesive, insulating material such as structural grade polyurethane foam, the ends of the flexible arched member being fixed to the lower skin member. Preferably, a solar energy collecting array is disposed upon each structural panel with means for interconnecting the solar arrays on adjacent panels. In a method of producing the panel, the upper and lower skin members and the flexible arched member are arranged in the manner described above whereupon the foam is injected therebetween to maintain the flexible member in its arched configuration. In a method of forming a surface upon a structure having spaced vertical supports at each end with a plurality of such panels, the panels are arranged so that the load bearing ends of the arched member in each panel span the distance between the support means, the joints between the adjacent panels being sealed and fitted to provide a continuous surface.

42546 **Solar energy collector apparatus.** Pei, Y.K. (to Owens-Illinois, Inc.). US Patent 4,048,983. 20 Sep 1977. Filed date 3 May 1976. 8p.

The disclosure relates to a three piece solar energy bulb type collector device comprising a hollow glass body shaped with a parabolic interior surface that is coated with specular finish of a metal, e.g. silver, and includes an apex aperture and integral hollow yoke. A glass test-tube like element is exteriorly coated with a wave length selective coating having more than 0.8 absorption above 2.5 microns wavelength and less than 0.1 emission at 2.5 microns or less wavelengths. The coated glass tube is the absorber and has an intermediate rib and flared open end which are fused with glass at the aperture area and open end of the yoke. The absorber is coaxially located with the focal axis of the parabolic surface. A cover plate is sealed over the large end of the parabolic body enclosing the interior mirror surface area in a chamber which is placed under vacuum (evacuated). Working media, which may be either gas or liquid, is circulated from a manifold through the absorber tube to remove solar energy as heat, and is returned to the manifold. The solar energy laden media is available for heating, cooling or power generating applications.

42547 **Method and apparatus for receiving solar energy.** Arnberg, B.T. US Patent 4,047,517. 13 Sep 1977. Filed date 6 Jul 1976. 8p.

A method and apparatus is described for receiving solar energy reflected from a heliostat configuration in which the apparatus is formed of converging vanes defining cavities therebetween, and preferably converging towards a cavity. The vanes may partially or completely define an enclosed volume. Surfaces of the vanes are provided with reflective surfaces near the outer portions of the receiver, selective surfaces at the intermediate portions and, optionally, absorbing surfaces at the interior portions. Cooling means are

provided within the vanes of the receiver adjacent the selective and absorbing surfaces. In a preferred embodiment, a transparent barrier is provided transverse to the vanes substantially at the change from the reflective to the selective surfaces, and an infrared absorbing heat transfer fluid is flowed inwardly from the transparent barrier to the cavity to cool the receiver and absorb energy irradiated from the vanes and cavity.

42548 Three-dimensional tracking solar energy concentrator and method for making same. Miller, C.G.; Pohl, J.G. (to National Aeronautics and Space Administration). US Patent 4,046,462. 6 Sep 1977. Filed date 28 Apr 1976. 6p.

A three dimensional tracking solar energy concentrator, consisting of a stretched aluminized polymeric membrane supported by a hoop, was presented. The system is sturdy enough to withstand expected windage forces and precipitation. It can provide the high temperature output needed by central station power plants for power production in the multi-megawatt range.

42549 Solar collector automatic freeze protection system. Cronin, P.W.; Ottmar, P.H.; Root, E.F.; Simmons, H.M. (to Itek Corp.). US Patent 4,044,754. 30 Aug 1977. Filed date 10 May 1976. 6p.

An automatic freeze protection system is described for solar energy collector apparatus. The apparatus includes a solar collector for circulating water or another fluid to be heated by the sun. Sensor means are provided within the collector to monitor the temperature of the water, and whenever it approaches the freezing point, the sensor will automatically actuate a valve means to rapidly drain the water from the collector. When the temperature within the collector thereafter rises to a predetermined safe level, the sensor means will again automatically actuate the valve means to refill the collector with fresh water to be heated. The system provided thus avoids the need for anti-freeze or other freeze protection materials suggested by the prior art as well as isolated water loops, heat exchangers and other expensive safety equipment necessitated thereby.

42550 Apparatus for concentration of solar radiation. Rust, R. US Patent 4,040,411. 9 Aug 1977. Filed date 10 Sep 1975. 6p.

An apparatus is described for the concentration of solar radiation to a utilizable flux by directing it vertically downward upon the reflecting surface of a rotating liquid and utilizing the concentrated radiation at or near the focal point. The resulting optical system is comprised of the combination of the paraboloid of revolution at the rotating surface of liquid, the reflecting plane surfaces used to direct the suns rays vertically downward, and shaped reflectors which may be used to direct the concentrated radiation to a radiation to enthalpy heat exchanger.

42551 Evacuated solar heat collector. Lyon, F.A. (to Halm Instrument Co., Inc.). US Patent 4,038,965. 2 Aug 1977. Filed date 23 Jul 1975. 4p.

In a solar heat collector are a shallow hollow member, a transparent cover for said member, and a plurality of load bearing partitions in said howllow member. A plurality of load bearing partitions in said hollow member. A plurality of heat collecting plates are spaced between said partitions. A plurality of water pipes are each connected along one of said collector plates and the water pipes are connected in parallel. Inlet and outlet water pipe means are connected to the parallel connected pipes. The outlet pipe connection has an expansion loop to compensate for temperature variations. Vacuum is applied to the hollow member. The partitions are proportioned and spaced so as to support the cover against external atmospheric pressure. Conduction and convection losses from said heat collector plates are minimized because of the vacuum.

42552 Solar heat collector tank. Harrison, H. (to Halm Instrument Co., Inc.). US Patent 4,038,966. 2 Aug 1977. Filed date 9 Oct 1975. 4p.

A solar heat collector is described. A thin evacuated tank has upper and lower parallel sides, the upper side having a black exterior surface, the tank being mounted at an angle to the horizontal. A small amount of vaporizable fluid is contained in the tank. A fluid conduit is connected in heat exchanging relation with the upper end of the tank. Solar rays striking said upper tank surface will vaporize the fluid in the tank and the vapor will flow to the upper portion of the tank where it will be condensed and transfer its heat to fluid in the conduit.

42553 Solar energy collector. Smith, P.D. US Patent 4,038,969. 2 Aug 1977. Filed date 20 Nov 1974. 6p.

A solar collector is disclosed which collects radiant energy for transfer as thermal energy to a fluid with high efficiency. An energy absorbing structure is mounted between a transparent front panel and opaque back panel of a housing. The energy absorbing structure comprises a plurality of open-ended cells having parallel axes which are oriented at right angles to the transparent panel for receiving the radiant energy. Pairs of adjacent cells share common sidewalls to achieve a high surface area to frontal area ratio. The surfaces of the sidewalls have a high absorbtivity coefficient for efficiently absorbing the radiant energy, and the sidewalls have a high thermal conductivity for efficiently tranfering thermal energy to a fluid which is directed through the cells. In one embodiment the cells are polygonal in cross-section to form a honeycomb structure, and in another embodiment the cells are substantially circular in cross-section. Means is provided to direct a fluid such as air or water into the housing and through the cells in heat exchange relationship with the sidewalls for absorbing and carrying away the energy collected by the cells.

42554 Tubular solar energy collection system utilizing air media. Moan, K.L. (to Owens-Illinois, Inc.). US Patent 4,016,860. 12 Apr 1977. Filed date 12 Jan 1976. 8p.

An air system is described for the collection and utilization of solar energy. Tubular solar collectors are made with a transparent glass tube having a cylindrical outer wall, spaced and sealed at one end to a cylindrical absorber tube that has a solar energy absorbing surface. The sealed space between the glass tube and absorber tube is evacuated. Several of the collectors are connected into a manifold split into separate chambers by a dividing wall. A divider strip is fastened as a continuation of the dividing wall of the manifold by a novel detachable fastener means. The divider strip fits snugly inside the absorber tube of each collector dividing it in half and spanning nearly the entire length thereof. Pressurized air is supplied into the one high pressure chamber of the manifold and is connected into the one half section of the absorber of each collector at the open end connection, guided by the dividing strip the length of the absorber tube into the other half of the absorber tube and back into the other compartment of the manifold which is at lower pressure. The reverse flow of air the length of the absorber tube exchanges solar heat absorbed on the solar energy absorbing surface. Heated air in the lower pressure chamber is conveyed to a heat exchange storage element and/or load device operable for heating or cooling purposes.

HEAT STORAGE

REFER ALSO TO CITATION(S) 42515, 42536

42555 (SAND—78-8500) **Summary of energy storage activities within ERDA's Division of Solar Energy central receiver program.** Brumleve, T.D. (Sandia Labs., Livermore, Calif. (USA)). Mar 1978. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Energy storage activities within the ERDA Solar Central Receiver Program are reviewed. Analyses and moderate-scale experiments were performed by three contractor teams as part of the preliminary design of the Barstow, California 10 MW/sub e/ Pilot Plant. Other storage investigations related to advanced central receiver systems are also described.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 42102, 43120

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 43147

NON-USA

42556 (CONF-770364—13) **Outline of the research and development of geothermal energy technology in the Sunshine Project.** (Corporate Unverified). 1977. 9p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

In Japan most of the natural hydrothermal reservoirs developed for power generation, air conditioning, snow thawing and agricultural use are located at relatively shallow (1 to 2 km) depths. The number of operating plants in 1974 and 1975 was four, having a capacity of about 70 MW. Three plants were under construction which would provide an additional 150 MW. All use natural steam as the motive agent. If reservoirs at depths greater than 2 km are exploited the capacity for power generation would progressively increase. The development of exploration and drilling techniques has been advanced by the production of remote sensing and automatic drilling equipment capable of operation at 400°C and 500 atm. Binary power generation turbine systems are under development and

if successful it is predicted that Japanese generating capacity will reach 10 GW by the year 2000.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 43753, 43767

42557 Effect of dike intrusion on free convection in conduction-dominated geothermal reservoirs. Lau, K.H.; Cheng, P. (Univ. of Hawaii, Honolulu). *Int. J. Heat Mass Transfer;* **20**: No. 11, 1205-1210(Nov 1977).

A perturbation analysis is made for the study of the effect of dike intrusion on free convection in unconfined conduction-dominated geothermal reservoirs. The perturbation equations are of elliptic type that can be solved numerically by the finite difference method. Up to the second-order approximations are retained in the numerical computation. The effects of dike intrusion on streamlines, temperature distribution, and the shape of water table in a two-dimensional volcanic island aquifer are shown.

USA

42558 Volcanic structure of the crest of the Puna Ridge, Hawaii: geophysical implications of submarine volcanic terrain. Fornari, D.J.; Malahoff, A.; Heezen, B.C. *Geol. Soc. Am., Bull.;* **89**: No. 4, 605-616(Apr 1978).

The morphology of submarine volcanic terrain on the crest of the Puna Ridge, Hawaii, was observed during two manned submersible dives in water depths of as much as 2,000 m. Steep-walled linear ridges 30 m high, trending 060°, and composed of lava pillows and narrow fissures with the same strike were the principal volcanic features observed on the ridge crest. Lava tunnels, tubes, and pillows frequently were observed to be partially broken through, thereby exposing water-filled voids, which are inferred to be interconnected to great depths within the extrusive submarine volcanic pile. Low compressional wave velocities reported by other authors for the crustal layer composed of submarine volcanic extrusives and the low effective density of this layer, as determined from published surface gravity observations, are attributed to the large intraflow and interflow porosity of submarine volcanic terrain. Areal variations in heat flow through the crust of submarine volcanic features are also attributed to the high porosity and consequent permeability of submarine volcanic terrain which is likely to persist to the bottom of the submarine extrusive pile.

NON-USA

42559 Recharge of water in Wairakei Geothermal Field determined from repeat gravity measurements. Hunt, T.M. (DSIR, Wellington, New Zealand). *N.Z. J. Geol. Geophys.;* **20**: No. 2, 303-317(1977).

Repeat gravity measurements at Wairakei Geothermal Field, New Zealand, indicate for the period 1958 to 1961 about 44×10^9 kg of water replaced 145×10^9 kg withdrawn, for 1961 to 1967 about 126×10^9 kg replaced 360×10^9 kg withdrawn, and for 1967 to 1974 about 364×10^9 kg replaced 400×10^9 kg withdrawn. The amount of recharge appears to be inversely related to the rate of change of corrected gravity values at benchmark A97 in the main production borefield. Using this relationship it is estimated that during the initial period of exploitation (1958 to 1962) the annual recharge dropped to about 10 percent, but subsequently rose, and since 1966 has been about 90 percent. In any period, the mass replaced has not exceeded that withdrawn, but since 1966 the net mass loss has been small, and at the present rate of withdrawal it is unlikely that the field will be depleted of water for a long time.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 42100

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 43769, 43770, 43771

42560 (CONF-770364—10) **Research and development of methods for investigation of large thermal areas.** (Corporate Unverified). 1977. 13p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

In order to elucidate the underground thermal structure of geothermal fields through the use of comprehensive analysis of information such as heat flow, temperature of subterranean strata, and seismic data from small scale earthquakes, a test area was established. This area was centered in Hachimandaira National Park and included about 160 km^2. Included in the area were Onuma, Tamagawa, Tsunagi and Oshuku hot springs. During 1974 (the first year of the study) a multi-point temperature gradient meter and a well logging thermometer were developed. For thermal conductivity measurements a fast probe conductivity meter manufactured by Showa Denko (ATM-D1) was selected. This device was used in test wells of 80 to 500 m depth. In the 500 m deep well the hydrothermally altered layer belonged to the outermost and least altered zone and the filling temperature of liquid inclusions was found to be 165 to 280°C.

42561 (CONF-770364—11) **Feasibility study on volcanic power generation system.** (Corporate Unverified). 1977. 25p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

Investigations were carried out to determine the feasibility of volcanic power generation on Satsuma Io Island. Earthquakes were studied, as were the eruptions of subaerial and submarine hot springs. Hydrothermal rock alteration was studied and electrical surveys were made. General geophysical surveying was performed with thermocameras and radiation monitoring equipment. In particular, the Toyoba mine was studied, both with respect to its hot spring and its subsurface temperatures.

42562 (LA—7228-MS) **Seismic reflection surveys near LASL geothermal site.** Kintzinger, P.R.; Reynolds, C.B.; West, F.G.; Suhr, G. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

Data and interpretations are presented for a seismic reflection survey in the Barley Canyon area of the Jemez Mountains, Sandoval County, New Mexico, on the north side of the Los Alamos Scientific Laboratory Hot Dry Rock Project, Fenton Hill Site. Some results of an earlier (1974) seismic reflection of the south portion of the Hot Dry Rock Project area are included. Possible correlations of geologic structure between the two surveys are indicated.

42563 (LA-UR—78-1240) **Thermal conductivity of rocks associated with energy extraction from hot dry rock geothermal systems.** Sibbitt, W.L.; Dodson, J.G.; Tester, J.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 25p. (CONF-770847—7). Dep. NTIS, PC A02/MF A01.

From 15. international thermal conductivity conference; Ottawa, Ontario, Canada (24 Aug 1977).

Results of thermal conductivity measurements are given for 14 drill core rock samples taken from two exploratory HDR geothermal wellbores (maximum depth of 2929 m (9608 ft) drilled into Precambrian granitic rock in the Jemez Mountains of northern New Mexico. These samples have been petrographically characterized and in general represent fresh competent Precambrian material of deep origin. Thermal conductivities, modal analyses, and densities are given for all core samples studied under dry and water-saturated conditions. Additional measurements are reported for several sedimentary rocks encountered in the upper 760 m (2500 ft) of that same region. A cut-bar thermal conductivity comparator and a transient needle probe were used for the determinations with fused quartz and Pyroceram 9606 as the standards. The maximum temperature range of the measurements was from the ice point to 250°C. The measurements on wet, water-saturated rock were limited to the temperature range below room temperature. Conductivity values of the dense core rock samples were generally within the range from 2 to 2.9 W/mK at 200°C. Excellent agreement was achieved between these laboratory measurements of thermal conductivity and those obtained by in situ measurements used in the HDR wellbores. By using samples of sufficient thickness to provide a statistically representative heat flow path, no difference between conductivity values and their temperature coefficients for orthogonal directions (heat flow parallel or perpendicular to core axis) was observed. This isotropic behavior was even found for highly foliated gneissic specimens. Estimates of thermal conductivity based on a composite dispersion analysis utilizing pure minerallic phase conductivities and detailed modal analyses usually agreed to within 9 percent of the experimental values.

42564 Hydrosounding as a method of study of the critical parameters of the geyser. Steinberg, G.S. (MKB Geographical Society, Petropavlosk-Kamchatskii, USSR); Merzhanov, A.G.; Steinberg, A.S. *J. Volcanol. Geotherm. Res.;* **3**: 99-119(1978).

A new method of hydrosounding was devised for clarifying the geyser regime and for determining critical conditions that are essential for geysers to erupt. The method consists of pouring known quantities of water into the geyser system and then measuring

changes in the main characteristics of the geyser, i.e., the duration of the eruptive stages and the temperature and quantity of the added and erupted water. The temperature and mass of the added sounding water can be varied and used to provide a series of equations that give average enthalpy of heat-carrying fluids, their natural rate of inflow to the local geyser reservoir, and variations in the process of filling the system, the free volume after eruption and other factors. Experiments were carried out in Quathegey and Prince Buratino geysers of Geyser Valley, Kamchatka. The average enthalpies of the heat-carrying fluids are calculated to be 164 to 174 kcal/kg and 180 to 195 kcal/kg, respectively.

42565 Applications of the VLF induction method for studying some volcanic processes of Kilauea volcano, Hawaii. Zablocki, C.J. (Geological Survey, Denver). *J. Volcanol. Geotherm. Res.;* **3**: 155-195(1978).

The very low-frequency (VLF) induction method has found exceptional utility in studying various volcanic processes of Kilauea volcano, Hawaii because: significant anomalies result exclusively from ionically conductive magma or still-hot intrusions (>800°C) and the attendant electrolytically conductive hot groundwater; basalt flows forming the bulk of Kilauea have very high resistivities at shallow depths that result in low geologic noise levels and relatively deep depths of investigation (approximately 100 m); and the azimuths to two of the usable trasmitters (NLK and NPM) are aligned favorable with most of the principal geologic features. Measurements of the tilt angle and ellipticity of the polarization ellipse of the magnetic field, using a simple, hand-held receiver, have been used to: delineate the lateral extent of shallow, partially solidified lava lakes, active lava tubes, and recent intrusive dikes; obtain an indication of the attiude of some recent dikes; show that many eruptive fissures cool faster than their intrusive counterparts; show that some fumarolic areas are underlain by shallow, highly altered, and conductive zones; and provide control information for interpreting data obtained with other electrical techniques. Complementary measurements of scalar apparent resistivity and surface impedance phase, using a new attachment for the VLF receiver, have substantially increased the utility of VLF studies in Kilauea. They provide better lateral resolution of conductors and reduce the ambiguity in interpretation. These VLF induction methods should have wide application to studies of active volcanic regions in other parts of the world and could provide some insights into the workings of larger-scaled geothermal systems.

42566 Thermal evolution models for the Valles caldera with reference to a hot-dry-rock geothermal experiment. Kolstad, C.D.; McGetchin, T.R. (Los Alamos Scientific Lab., NM). *J. Volcanol. Geotherm. Res.;* **3**: 197-218(1978).

A two-dimensional finite element heat conduction model was formulated and used to investigate the thermal evolution of the Valles volcanic complex and caldera in the Jemez Mountains of northern New Mexico. The Valles complex is currently being extensively explored for geothermal energy within the caldera by commercial interests seeking hydrothermal resources. In addition, a number of test wells have been drilled just outside the caldera's west margin by Los Alamos Scientific Laboratory to test a potential hot-dry-rock (HDR) geothermal energy extraction technique. It is assumed that a magma chamber was emplaced under the Valles complex prior to the last large ash-flow eruption 1.04 m.y. ago; calculations of thermal evolution to the present are compared with heat flow and temperature measurements made in the geothermal test holes in and near the caldera. Results indicate that: a partly molten magma chamber may still reside beneath the Valles complex; the magma chamber may have extended initially beyond the margin of the caldera as defined by the ring fracture system; and the top of the magma chamber may have originally been just below the present bottom of the HDR test holes, at 3 km, so that further drilling may encounter very young, recently crystallized granite.

42567 Types of geothermal curves and their interpretation. Dzhangir'yants, D.A. *J. Geophys. Res.;* **19**: No. 2, 245-248(Feb 1977).

Translated from Sov. Geol.; No. 12, 138-141(1975).

On the basis of an analysis of thermometric data from deep drill holes in Western Kazakhstan, characteristics of types of thermal curves (linear, convex, concave, etc.) are recognized from the nature of the change in the geothermal gradient. Angles of slope of the clusters of the thermal curves and their position on the graph are determined by the degree of the principal regions of supply and the heat flow from depth, the geologic construction, the lithologic-facies composition of the rocks, the hydrogeologic conditions, etc. Graphs of the clusters of thermal curves enable us to provide a comparative estimate of the effect of these factors on the geothermal regime of individual sectors of the region, and to trace the change in depth of occurrence of the isothermal surfaces as well as the distribution of temperatures in various depth intervals.

42568 Profiling the Rio Grande Rift. Oliver, J.; Kaufman, S. (Cornell Univ., Ithaca, NY). *Geotimes;* **21**: No. 7, 20-23(Jul 1976).

Initial results of field work in the eastern margin of the Albuquerque-Belen Basin of the Rio Grande Rift in central New Mexico are reported. The seismic-reflection technique was used successfully in the spatial resolution of geological features of basement rocks. (JGB)

GEOCHEMICAL TECHNIQUES AND SURVEYS

42569 (CONF-7610123—1) **Arsenic, antimony, and mercury contents of Nakayamadaira hot spring in Miyagi Prefecture.** Suzuki, T.; Watanabe, J. (Corporate Unverified). 1975. 1p. (In Japanese). TIC.

From Annual meeting of the Geochemical Society of Japan; Nagoya, Japan (25 Oct 1976).

Portions of document are illegible.

The Nakayamadaira hot spring in Naruko-machi, Miyagi prefecture was analyzed chemically. The arsenic content was 0.02 mg/liter to 3.02 mg/liter. The amounts of arsenic and antimony were related, as were the Sb and Cl content. The amount of mercury present ranged from 0.0 to 0.62 micrograms/liter. No correlation was found between pH and Hg, Cl and Hg or SO_4 and Hg. The fluorine content ranged from 0.4 to 4.3 mg/liter. Correlations were found between temperature and fluorine and between chlorine and fluorine.

42570 (CONF-7610123—3) **Geochemical geothermal exploitation by Hg and CO_2 present in air and soil.** Koga, A.; Noda, T. (Corporate Unverified). 1975. 1p. (In Japanese). TIC.

From Annual meeting of the Geochemical Society of Japan; Nagoya, Japan (25 Oct 1976).

Portions of document are illegible.

It has been known since 1973 that the measurement of mercury is a valuable technique in geothermal exploration. In areas with no surface indications of geothermal activity it is the only technique which can be used. Due to the high volatility and surface potential of mercury, the vapor tends to migrate to the surface in geothermal areas and concentrate in the soil. The availability and size of geothermal areas can be readily detected by this method. The presence of CO_2 in drill cores is also a useful indicator of geothermal activity.

42571 (NP—23185) **Ecological impact on the Waikato River of untreated effluent from the proposed Broadlands Geothermal Power Station. Report No. 26.** Coulter, G.W. (Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.). Nov 1977. 35p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Physical, chemical, and biological characteristics of the Waikato River between Lake Taupo and Ohakuri Dam were studied to enable prediction of likely ecological consequences of adding effluent from the Broadlands Geothermal Power Station. The chemical composition of the river in this section is much influenced by natural geothermal inputs. Ecological effects of man-made changes, including damming and introduction of exotic biota, must already have been considerable, and the river is stressed daily by regimes of discharge and geothermal effluent input imposed by power production. Oligotrophic water from Lake Taupo is chemically enriched in the Lake Ohakuri sub-catchment and Lake Ohakuri, which will in effect be the receiving water for the Broadlands Station effluent, is eutrophic. Direct open-circuit cooling of the power plant using river water would result in environmentally unacceptable increases in river temperature. Adverse thermal effects on biota by the effluent would be likely in summer during river discharges less than 40 m^3/s. Nutrient addition by bore water should not have marked eutrophic consequences, but if much ammonia from the steam phase enters the cooling water and the river significant worsening of eutrophic conditions could occur in Lake Ohakuri and lakes downstream. Toxic effects would largely concern increase in arsenic concentration above acceptable levels for drinking water further north than at present, and damage by boron to irrigated fruit and vegetables. These findings stress the need to relate the amounts of eutrophicating or toxic inputs to the assimilative capacity of the river. Disposal of the Broadlands effluent by deep re-injection into the field would be an environmentally better solution.

42572 (UCID—4035) **Geothermal emissions data base, Wairakei geothermal field.** Schwartz, S.R. (comp.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 414p. Dep. NTIS, PC A18/MF A01.

A database subset on the gaseous emissions from the Wairakei geothermal field is presented. Properties and states of the reservoir fluid such as flow rates, wellhead pressure, and enthalpy are included in the file along with the well name and constituent measurement. This subset is the result of an initial screening of the data covering 1965 to 1971, and new additions will be appended periodically to the file. The data is accessed by a database management system as are all other subsets in the file. Thereby, one may search the database for specific data requirements and print selective output. For example, one may wish to locate reservoir conditions for cases only when the level of the constituent exceeded a designated value. Data output is

available in the form of numerical compilations such as the attached, or graphical displays disposed to paper, film or magnetic tape.

42573 **^{87}Rb—^{87}Sr studies of waters in a geothermal area: the Cantal, France.** Stettler, A.; Allegre, C.J. (Univ., Paris). *Earth Planet. Sci. Lett.;* **38**: No. 2, 364-372(15 Feb 1978).

K, Rb, and Sr concentrations and $^{87}Sr/^{86}Sr$ ratios were determined in fresh surface waters, a rain water sample, and five geothermal waters from the Cantal volcanic area in the Massif Central, France. A comparison with appropriate rock types of the region showed no apparent chemical and isotopic fractionation occurring in the fresh water—surface rock system. The thermomineral water results suggest that all springs discharge dissolved Sr from the following contributors: Hercynian granito-metamorphic basement, lacustrian sediments underlying the volcano, Miocene-Pliocene volcanic rocks of basaltic to rhyolitic composition.

EXPLORATORY DRILLING AND WELL LOGGING

42574 (CONF-770364—5) **Feasibility study on internal well measurements.** (Corporate Unverified). 1977. 5p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

Various problems concerning the logging of geothermal wells were discussed. The topics included chemical logging apparatus: high temperature fracture logging equipment; slope meters for assessing stratigraphic traps; bottom samplers and pressure testers; cable materials; and systems for data processing and retrieval.

42575 (NVO—184(Suppl.1)) **Testing operations plan: Coso Geothermal Exploratory Hole No. 1 (CGEH-1).** (Department of Energy, Las Vegas, Nev. (USA). Nevada Operations Office; Naval Weapons Center, China Lake, Calif. (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.; CER Corp., Las Vegas, Nev. (USA)). Feb 1978. 31p. Dep. NTIS, PC A03/MF A01.

Coso Geothermal Exploratory Hole No. 1 (CGEH-1) was drilled to investigate the potential of the Coso Hot Springs Known Geothermal Resource Area (KGRA) in southeastern California. Detailed background information is contained in the drilling plan, "Coso Geothermal Exploratory Hole No. 1 (CGEH-1)," NVO-184, dated June 1977. The purpose of this supplement to NVO-184 is to establish a plan of operations for testing the resource after completion of well drilling activities. Major elements of this plan include setting forth the management and organizational concept to be followed, describing the generalized site activities required and the well testing operations, and establishing schedules, environmental considerations, and technical documentation requirements. The objective of this testing is to determine the well productivity and geothermal reservoir parameters. The testing will consist of both static and dynamic measurements. The static measurements will include wellhead pressure monitoring plus downhole temperature and pressure surveys conducted with the well shut in. The dynamic measurements will include downhole and surface pressure, temperature, and flow rate data with the well producing at varying rates. Two types of dynamic tests are contemplated; the first utilizing the James method and the second utilizing a separator test system, if justified by an evaluation of the resource potential.

42576 (UCRL—52421) **Potential uses for a high-temperature borehole gravimeter.** Hearst, J.R.; Kasameyer, P.W.; Owen, L.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Mar 1978. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

It is possible to design a canister to cool a borehole gravimeter for use in geothermal and high-temperature (up to 350°C) gas wells. Repeat surveys with such a gravimeter could (1) help estimate the extent of reservoir plugging in geothermal injection well after one year of operation and (2) detect compaction of a geothermal aquifer if the change in thickness of the aquifer exceeds 1 m. The instrument could be used together with conventional logging tools to evaluate radial dependence of density around a well, or to estimate gas-filled porosity around wells drilled with mud. A high-temperature borehole gravimeter could also be used to evaluate structure and stratigraphy around geothermal and high-temperature gas wells.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 42580

42577 **Water that is not water.** Olpin, O.; Tarlock, A.D. *Land Water Law Rev.;* **13**: No. 2, 391-440(1978).

The relationship between western water law and geothermal resources development is analyzed. An argument against the blanket application of western water law is presented, and a means of accommodating geothermal resources development with the protection of conventional water users is proposed.

42578 **Land and water law review.** Lang, E.A. Jr. (ed.). Laramie, WY; Univ. of Wyoming (1977). 376p. (CONF-770135—).

From Geothermal Resources Development Institute conference; Salt Lake City, UT, USA (27 Jan 1977).

Fourteen papers and a geothermal bibliography are included. Individual papers have been previously abstracted and indexed individually and included in ERA/EDB as part of the conference proceedings. (JGB)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 42571, 42590, 43612

42579 (CONF-770364—19) **View of technology concerning pollution control (environmental protection) in geothermal development.** Nakamura, H. (Corporate Unverified). 1977. 19p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

Studies were made of various environmental problems associated with geothermal energy. Among these were ground subsidence, water pollution, air pollution, and disruption due to plant construction. At the time of reporting, hydrogen sulfide was being discharged directly to the atmosphere in Japan. An expert committee from the Resource and Energy Agency is studying atmospheric dispersion with a view to placing constraints on such discharge. The reinjection of waste geothermal fluid is also being closely studied as a means of maintaining the supply. In the Otake field it was found that pressure drop in the steam supply leveled off and slightly increased after reinjection was begun.

42580 (CONF-770364—20) **Total assessment practice in connection with multi-purpose utilization of geothermal energy.** Honda, S. (Corporate Unverified). 1977. 10p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

In order to totally assess the development of geothermal energy in Japan the geothermal fields were divided into characteristic regions. In the Takinokami district it is planned to use the hot water underlying the area between Shizukuishi and Morioka City. A detailed study was made of transportation, heat balance, and the impact of geothermal development on both the natural environment and the social community. Environmental impact resulting from plant construction, ground temperature increase, noise and accidental disasters was carefully assessed. The only problem identified was depletion of the hot water supply. This being controllable, it was decided that the plan could be promoted without difficulty.

42581 (PNL—2500(Pt.4), pp 3.1-3.2) **Heavy metal and noxious gas emissions from geothermal resource development.** Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Studies initiated to identify the quantity and chemical form of volatile and water-soluble heavy metals released in geothermal effluents are reported. Hg and As concentrations in fluids at various sites are compared. Concentrations of H_2S and Rn are also discussed. Preliminary results of the measurement of potentially toxic materials in geopressured geothermal fluids are reported. (JGB)

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 42613

42582 (CONF-770364—3) **Research and development of hydrothermal binary cycle power generation system.** (Corporate Unverified). 1977. 13p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

In order to further the capabilities of geothermal electrical power generation a binary cycle power generation system was studied. The primary goals were to develop a heat exchanger to extract the heat of geothermal well water and transfer it to a low-temperature vaporizing fluid, and to develop a 1 MW thermal loop test facility to evaluate the possibility of building a 10 to 50 MW binary cycle generating station. The development of specific materi-

als for the system was also considered. Almost satisfactory results were obtained concerning the design of the heat exchanger, and the characteristics of the thermal loop turbine, generator and piping were decided upon. Flow charts and system designs are provided as well as material performance graphs.

GEOTHERMAL ENGINEERING

42583 (LA—7109-PR) **Hot Dry Rock Geothermal Energy Development Project. Annual report, fiscal year 1977.** (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1978. Contract W-7405-ENG-36. 300p. Dep. NTIS, PC A13/MF A01.

The feasibility of extracting geothermal energy from hot dry rock in the earth's crust was investigated. The concept being investigated involves drilling a deep hole, creating an artificial geothermal reservoir at the bottom of the hole by hydraulic fracturing, and then intersecting the fracture with a second borehole. At the beginning of FY77, the downhole system was complete, but the impedance to the flow of fluid was too high to proceed confidently with the planned energy extraction demonstration. Therefore, in FY77 work focused on an intensive investigation of the characteristics of the downhole system and on the development of the necessary tools and techniques for understanding and improving it. Research results are presented under the following section headings: introduction and history; hot dry rock resource assessment and site selection; instrumentation and equipment development; drilling and fracturing; reservoir engineering; energy extraction system; environmental studies; project management and liaison; and, looking back and ahead. (JGB)

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 42556, 42588

42584 (CONF-770364—6) **Feasibility study of the drilling of high temperature strata.** (Corporate Unverified). 1977. 6p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

The objective of this feasibility study was the development of drilling techniques applicable under high temperatures and pressures. Conditions were assumed to be 3 to 5 km depth, temperatures of 250 to 400°C and pressure of about 500 kg/cm^2. These were chosen as typical of geothermal environments. Only rotary techniques were studied. It was recommended that a cooling device with a capacity of 1.0 to 2.0 Gcal/hour be provided for the drilling mud discharge. Improvements were recommended for casings and other drilling equipment to enable it to withstand highly corrosive and high thermal stress conditions. At a temperature of 250°C it was found that the bits could be kept at a workable peripheral temperature of 100°C. No existing materials were found, however, which were operable at ambient temperatures in the 400°C range.

42585 (TID—28320) **Support research for development of improved geothermal drill bits.** Hendrickson, R.R.; Barker, L.M.; Green, S.J.; Winzenried, R.W. (Terra Tek, Inc., Salt Lake City, Utah (USA)). Jun 1977. Contract EY-76-C-07-1546. 95p. Dep. NTIS, PC A05/MF A01.

Progress in background research needed to develop drill bits for the geothermal environment is reported. Construction of a full-scale geothermal wellbore simulator and geothermal seal testing machine was completed. Simulated tests were conducted on full-scale bits. Screening tests on elastometric seals under geothermal conditions are reported. (JGB)

42586 (TR—76-11) **Steady-state and transient wellbore temperatures during drilling.** McDonald, W.J. (Maurer Engineering, Inc., Houston, Tex. (USA)). 20 May 1976. Contract EY-76-C-07-1546;EY-76-C-07-1603. 38p. Dep. NTIS, PC A03/MF A01.

An extensive literature search was made to locate technical publications and computer programs relating to wellbore temperatures during drilling operations. The search confirmed the need for knowledge of transient and steady state circulating temperatures in the design of geothermal bits. Two approaches were used in calculating borehole temperatures. The steady state solution of Holmes and Swift was programmed and 2100 cases calculated for various borehole configurations. For transient temperature studies, calculations were made for ten borehole configurations. These calculations help emphasize the need for better high temperature bit performance and improved engineering procedures in drilling. The conclusions and recommendations are based on latest available technology for calculating wellbore temperatures.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

42587 (CONF-770364—2) **Hydrothermal power generation technology-studies on development of materials for geothermal power generation.** (Corporate Unverified). 1977. 4p. (In Japanese). TIC.

From Meeting of the developmental results of geothermal energy in 1974 and 1975; Tokyo, Japan (Mar 1977).

Portions of document are illegible.

In order to develop materials durable under corrosive, high temperature and pressure geothermal environmental conditions, commercially available stainless and boronized steels were subjected to various tests. In one test they were immersed in saturated H_2S solution for periods of 5 to 25 hours at 200°C and 18 atm. The results showed that all specimens but the SUS 310 steel demonstrated corrosion in a similarly increasing slope. The stainless steels tended to resist corrosion in direct proportion to their Ni content. The electrochemical properties of soft and stainless steels were tested in a 0.1 molal sulfuric acid solution containing zero, 0.0001 and 0.01 mol/liter. The natural corrosive potential became remarkably basic under H_2S and reduced in the order SUS-316 greater than -310 greater than -309 greater than -304 greater than -430, and the passivation potential increased in the order SUS-316 less than -310 less than -309 less than -304 less than -430 which was similar to the results of the passivation current tests.

42588 (SAND—78-7008) **State of the art in well completion technology as applied to geothermal development. Preliminary report, including: Part I. Corrosion and metal problems. Part II. Scale deposition and control. Part III. General production interval completion techniques. Part IV. All-liquid heat recovery system model.** Jorda, R.M.; Ellis, R.C. (Completion Technology Co., Houston, Tex. (USA)). Nov 1977. Contract EY-76-C-04-0789. 160p. Dep. NTIS, PC A08/MF A01.

The preliminary phase of a state-of-the-art report concerning well completions for geopressured and geothermal energy source and injection wells is presented. The report covers corrosion and metal problems, scale deposition and control, general production interval completion techniques, and a model of an all-liquid heat recovery system. Both hot water geopressured source wells and water disposal (injection) wells are discussed in some detail. Areas for further development and study with regards to United States Gulf Coast geopressured well completions are identified (JGB)

42589 (UCRL—81019) **Polymeric and composite materials for use in systems utilizing hot, flowing geothermal brine. II.** Lorensen, L.E.; Walkup, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1978. Contract W-7405-ENG-48. 27p. (CONF-780611—2). Dep. NTIS, PC A03/MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

Further progress is reported on a continuing experimental program designed to select high-performance polymeric materials for use in geothermal power plants. In field tests 12 nozzles, 27 wear plates, and 2 types of polymer lined pipe were tested. Nozzles made of Teflons TFE and PFA, Tefzel, Ryton PPS and H-Resin/carbon cloth were little changed except for some scaling. The fluorocarbons scaled least rapidly. All blade type wear plates eroded, those based on Tefzel, PPQ, and PPS the least. Fluorocarbon lined pipes were little affected by exposure. In laboratory tests samples were heated at 250 and 300°C in brine. Several materials including fluorocarbon and unhydrolyzable aromatic or cross-linked aliphatic, thermally stable polymers survived for periods up to 1300 h. In erosion tests, coatings based on epoxy resins and a fluorocarbon were most resistant; good adhesion was required.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 42572, 42575, 42591

42590 (UCRL—80529) **Predicting the rate by which suspended solids plug geothermal injection wells.** Owens, L.B.; Kasameyer, P.W.; Netherton, R.; Thorson, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jan 1978. Contract W-7405-ENG-48. 10p. (CONF-771243—1). Dep. NTIS, PC A02/MF A01.

From 3. workshop on geothermal reservoir engineering; Palo Alto, CA, USA (14 Dec 1977).

Standard membrane filtration tests were used to evaluate injection at the Salton Sea Geothermal Field, Southern California. Results indicate that direct injection into reservoir zones with primary porosity is not feasible unless 1 μm or larger particulates formed during or after the energy conversion process are removed. (JGB)

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 42583

42591 Well stimulation and systems for recovering geothermal heat. Sheinbaum, I. US Patent 4,079,590. 21 Mar 1978. Filed date 7 Apr 1975. 12p.

The flow from geothermal wells is stimulated by injecting a liquid at selected levels in the well with the liquid having a boiling point below the temperature of the geothermal fluid at the levels of injection at the operating pressure at the levels of injection. The geothermal fluid and vaporized injected fluid from the well are applied to a system for extracting the heat energy as well as for cleaning sand and other well depositions that may accumulate in the geothermal well. The system may include a direct contact heat exchanger having either a vertical chamber or a horizontal chamber. The contactor has a plurality of zones including a boiler zone, one or more separation zones, and at least one heat exchange zone. The contactor may also include a wash zone and a flash zone. In the wash zone there is advantageously included recirculation trays vertically spaced for washing the vapor to remove entrained substances, such as minerals dissolved in the fluid from the geothermal wells. The recirculation trays include a manway for ease of access and service. The vaporized fluids from the contactor are passed through a power extracting gas expansion device, with the composition of the vapor being controlled to maximize the power extractable by the gas expansion device.

42592 Gravity head geothermal energy conversion system. Matthews, H.B. (to Sperry Rand Corp.). US Patent 4,077,220. 7 Mar 1978. Filed date 9 Nov 1976. 10p.

A geothermal energy recovery system of improved life duration makes use of thermal energy stored in hot, solute-bearing well water as it is pumped upward to the earth's surface through an extended heat exchange element for continuously heating a downward flowing organic working fluid to a supercritical state. Some of the energy of the latter fluid is used within the well for operating a turbine-driven pump for pumping the hot well water at high pressure and always in liquid state to the earth's surface, where it is reinjected into the earth in a second well. After driving the deep-well turbine-driven pump, the organic fluid still in supercritical state arises toward the earth's surface in a thermally insulated conduit; at the earth's surface, vapor turbine electrical power generation equipment is driven by the ascending organic fluid, after which it is returned into the well for re-heating in the extended heat exchanger. The invention provides a long life, closed-loop fluid lubricant pumping and cooling system for the bearings of the turbine and brine pump system, normally isolated from the working fluid loop and the hot brine pumping and heat exchange loop. Should the pressure level within the lubricant loop fall below a predetermined level, auxiliary means are provided for coupling working fluid into the lubrication loop to maintain the pressure within the loop above that of the hot brine, thus excluding intrusion of the corrosive brine.

DIRECT ENERGY UTILIZATION

42593 (SAN—1316-4) Feasibility of geothermal space/water heating for Mammoth Lakes Village, California. Final report, September 1976—September 1977. Sims, A.V.; Racine, W.C. (Holt (Ben) Co., Pasadena, Calif. (USA)). Dec 1977. Contract EY-76-C-03-1316. 129p. Dep. NTIS, PC A07/MF A01.

Results of a study to determine the technical, economic, and environmental feasibility of geothermal district heating for Mammoth Lakes Village, California are reported. The geothermal district heating system selected is technically feasible and will use existing technology in its design and operation. District heating can provide space and water heating energy for typical customers at lower cost than alternative sources of energy. If the district heating system is investor owned, lower costs are realized after five to six years of operation, and if owned by a nonprofit organization, after zero to three years. District heating offers lower costs than alternatives much sooner in time if co-generation and/or DOE participation in system construction are included in the analysis. During a preliminary environmental assessment, no potential adverse environmental impacts could be identified of sufficient consequence to preclude the construction and operation of the proposed district heating system. A follow-on program aimed at implementing district heating in Mammoth is outlined.

42594 (SAN—1328-1) Applications of geothermal resources in the evaporation and crystallization industry. Final report, September 1976—October 1977. May, S.C.; Basuino, D.J.; Doyle, P.T.; Rogers, A.N. (Bechtel Corp., San Francisco, Calif. (USA)). Oct 1977. Contract EY-76-C-03-1328. 174p. Dep. NTIS, PC A08/MF A01.

The objective in this study was to determine the technical and economic feasibility of using low-temperature geothermal energy (hot brines) in place of steam from conventional sources in the evaporation and crystallization industry. A survey of major industries was carried out in order to choose three industries that were significant users of energy, could utilize geothermal brine, and demonstrate the broad range of industrial evaporation and crystallization operations. The selected industries were the preserved fruit and vegetable, sugar and confectionary products, and chemical industries. From among each of the selected industries, an example case was chosen for technical and economic evaluation. This evaluation included use of the "feed-and-bleed" process for energy extraction from the low-temperature geothermal brine. This process was chosen as the best process to use because it provides one of the most efficient means of utilizing geothermal brine in evaporation/crystallization operations. This study concludes that, under certain conditions, geothermal energy could be used economically in the evaporation and crystallization industry. The factors that would most affect cost include geothermal resource characteristics (well flow, temperature, and distance of transportation); the energy extraction process chosen (the feed-and-bleed process uses the least amount of brine); and the duration of the evaporation/crystallization process. A program to aid in implementing the use of geothermal energy is included.

GEOTHERMAL DATA AND THEORY

REFER ALSO TO CITATION(S) 43766

42595 Viscous dissipation effects in magma conduits. Hardee, H.C.; Larson, D.W. (Sandia Labs., Albuquerque, NM). *J. Volcanol. Geotherm. Res.;* **2**: No. 3, 299-308(Sep 1977).

Fujii and Uyeda (1974) postulated that viscous dissipation may lead to thermal instability and explosive eruptions in the case of volcanic conduits or dikes. Although their conclusions were based on a viscosity function which was valid over a very narrow temperature range, calculations presented here lead to the same result for critical dike width. A simple forced intrusion model, without viscous dissipation effects, is also developed and found to be sufficient to explain the observed width of volcanic conduits and dikes. The mechanism of thermal runaway may present problems for magma energy extraction.

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 42283, 43375, 43376

42596 Calculation of the thermodynamic properties of aqueous silica and the solubility of quartz and its polymorphs at high pressures and temperatures. Walther, J.V.; Helgeson, H.C. (Univ. of California, Berkeley). *Am. J. Sci.;* **277**: No. 10, 1315-1351(Dec 1977).

Regression of experimental solubility data with theoretical equations providing for the intrinsic properties of SiO_2 and the calorimetric consequences of electrostriction collapse and solvation affords close approximation of the thermodynamic behavior of aqueous silica to 5 kb and 600°C. The standard molal volume of aqueous silica (V^0) decreases as a sigmoid function of temperature at constant pressure but increases as pressure increases at constant temperature. In contrast, the standard molal heat capacity (C^0/sub p/) maximizes with increasing pressure at intermediate temperatures. C^0/sub p/, which is negative at low temperatures, exhibits a maximum also as a function of temperature at constant pressure. Owing to the behavior of the partial derivatives of the dielectric constant of H_2O with respect to pressure and temperature, both V^0 and C^0/sub p/ approach -infinity at the critical point of H_2O, but at low temperatures where V^0 is positive, C^0/sub p/ is negative and decreases dramatically with decreasing temperature at constant pressure. The broad extrema exhibited by curves representing the solubility of α-quartz as a function of temperature at pressures ≦ a kilobar are a consequence of these variations in V^0 and C^0/sub p/. At high temperatures and low pressures, changes in the thermodynamic properties of aqueous silica are controlled primarily by the electrostatic properties of H_2O, but at low temperatures the local solvent structure dominates the temperature and pressure dependence of V^0 and C^0/sub p/. The geologic consequences of the thermodynamic behavior of aqueous silica can be predicted by combining the theoretical equations and regression coefficients with thermodynamic data for minerals and other aqueous species, which permits calculation of the distribution of SiO_2 among silicates and H_2O-rich hydrothermal solutions at high pressures and temperatures.

42597 Method of cement-solidifying radioactive liquid waste containing oil. Yasumura, K.; Matsuura, H. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-59,300/A/. 10 Nov 1975. 2p. (In Japanese).

A method is given to simply enclose radioactive waste containing oil into a vessel using cement solidifying material. Radioactive waste containing oil is put into a drum can up to a level slightly above one half of the can and then cement powder is put into the waste containing oil from the top of the drum can. At this time, the cement powder absorbs a small amount of oil content to form a layer

of cement and water at the bottom of the drum can. When the cement powder is further put, a layer of cement and oil content in the form of slurry is formed on the layer of cement and water content. Then, when surplus cement is further put on the thus formed layer of cement and oil content to accumulate thereon a layer of cement of about 10 to 20 cm and water in the form of shower is poured thereon to form a cement solidified body, the layer of cement and oil content in the form a slurry is completely covered and enclosed. At this time, a small amount of oil is run out on the cement solidified body from the layer of cement and oil content, but after several hours, such oil is absorbed into the cement solidified body.

PROPERTIES OF MINERALS AND ROCKS

42598 (CONF-770460—7) **Compressive strengths of high temperature rock.** Shigeo, M.; Kuriyagawa, T. (Corporate Unverified). 1977. 2p. (In Japanese). TIC.

From Spring meeting of the Mining and Metallurgical Institute of Japan; Tokyo, Japan (Apr 1977).

Experiments were performed to determine the compressive and tensile strengths of various rock types. The experiments were performed using a press equipped with a hemispherical tip of tungsten carbide at temperatures ranging from 0 to 650°C. The rock samples included Sori granite, Kofu andesite, and Emochi andesite. The compressive strength of the granite decreased from 0 to 200°C, then increased from 200 to 400°C, finally decreasing with further increase in temperature. The compressive strength of the Kofu andesite decreased from 0 to 200°C and increased with increasing temperature thereafter. The Emochi andesite demonstrated a nearly linear increase in strength with increasing temperature. The results of tensile strength tests were similar, except that in the case of the Emochi andesite a decrease in strength occurred from 0 to 200°C before the increase began. Graphs are also provided showing the relation of Young's modulus to temperature as well as specific energy/temperature.

ROCK-WATER-GAS INTERACTIONS

42599 **System: two alkali feldspars—KCl—NaCl—H_2O at moderate to high temperatures and low pressures.** Lagache, M. (Laboratoire de Geologie, Paris); Weisbrod, A. *Contrib. Mineral. Petrol.;* **62**: No. 1, 77-101(1977).

Because of frequent discrepancies between the available experimental data and the measured composition of alkali chloride aqueous solutions coexisting with two alkali feldspars in high temperatures—low pressures natural systems, a systematic investigation of the system $KAlSi_3O_8$—$NaAlSi_3O_8$—KCl—NaCl—H_2O was undertaken. Experiments were carried out at temperatures from 300 to 660°C, pressures from 0.2 to 2 kbar and total chloride concentrations ranging from 0.05 to 14 moles/kg H_2O. No effect of pressure on the feldspars solvus could be detected. Smoothing the experimental data on the basis of the regular asymmetric solid solution model yields a critical temperature of 661°C and a critical composition of $Or_{0.36}Ab_{0.64}$. The equilibrium constant C = m/sub KCl//m/sub NaCl/ does not depend on total chloride molality, as long as the aqueous solution is homogeneous. But, in the miscibility gap (liquid + vapor) of the fluid, C is always lower in the vapor than in the liquid. The higher the temperature and the lower the pressure, the more striking this effect. For instance, at 500°C: C/sub vapor//C/sub liquid/ = 1 above 1 kb, 0.9 at 600 bars, 0.8 at 500 bars, 0.7 at 400 to 450 bars. The effect of pressure can be neglected in homogeneous fluids and in the liquid phase of unmixed fluids, but it is important in the vapor phase (dilute solutions at low pressure). The selected values of C/sub max/ are (+- 0.01): 300°C: 0.083; 400°C: 0.139; 500°C: 0.200; 600°C: 0.264; 650°C: 0.298. Such behavior of the fluid at low pressures explains the abnormally low values of m/sub KCl//m/sub NaCl/ measured in many natural hydrothermal systems. A new mechanism of alkali metasomatism (especially potassic alterations) is also proposed, taking into account the unmixing of alkali chloride aqueous solutions. This model seems particularly interesting in late magmatic hydrothermal processes, such as those occurring in porphyry type deposits.

ISOTOPE AND TRACE ELEMENT STUDIES

42600 **Oxygen isotope distribution among mineral triplets in igneous and metamorphic rocks.** Deines, P. (Pennsylvania State Univ., University Park). *Geochim. Cosmochim. Acta;* **41**: No. 12, 1709-1730(Dec 1977).

A compilation of ^{18}O analyses of minerals separated from about 400 igneous and metamorphic rocks from published investigations reveals regularity in the fractionation of ^{18}O among associated minerals, suggesting that an approach to isotopic equilibrium may be common. However, for only a minority of terrestrial rocks are these regularities sufficiently systematic to be compatible with the actual attainment and preservation of isotopic equilibrium among three minerals. Fractionations among triplets of quartz, calcite, feldspar, muscovite, and magnetite show some correspondence to those expected on the basis of experimental calibrations; however, there are also considerable deviations. The variability of natural data is such that less than half of the rocks analyzed to date would yield concordant ^{18}O-derived temperatures. Of the additional 52 mineral triplets studied, plagioclase--pyroxene--ilmenite, plagioclase--pyroxene--magnetite, plagioclase--pyroxene--olivine, quartz--amphibole--garnet, pyroxene--ilmenite--magnetite, muscovite--biotite--magnetite, and quartz--muscovite--amphibole show the most systematic oxygen isotope fractionations. For 12 other mineral triplets a defined isotope fractionation relationship may be postulated to underlie the data; however for these a close approach to isotopic equilibrium is not commonly observed. For 33 of the mineral triplets an approach to isotopic equilibrium can be noted; however, the scatter of the available data is such that a systematic influence of a factor, such as temperature, on the size of the ^{18}O fractionation could not be detected. In the past, regularities of oxygen isotope fractionations among three minerals have been used to establish secondary isotope geothermometers. Before this can be done with any reliability, however, the effects of possible retrograde isotope exchange and spurious correlation must be accounted for.

42601 **Three-stage metamorphic history of a whiteschist from Sar e Sang, Afghanistan, as part of a former evaporite deposit.** Schreyer, W.; Abraham, K. (Ruhr-Universitaet, Bochum, Ger.). *Contrib. Mineral. Petrol.;* **59**: No. 2, 111-130(1976).

The partitioning of Sr between calcite, dolomite, and liquids is essentially independent of temperature between 150° and 350°C. The partition coefficients corrected for number of cation sites are b/sub calc/ = 0.096 and b/sub dol/ = 0.048 for 1 mol cations/6 mol H_2O liquid. Upon dilution the partition coefficients increase, but their ratio stays constant at about 2:1. This ratio is due to the fact that calcite has twice as many Ca-sites for Sr-substitution as dolomite. The 2:1 relationship is also observed in natural calcite and dolomite which have undergone diagenesis. The temperature independence of partitioning is caused by the relatively small thermal expansion of calcite and dolomite. Thermal expansion between 25° and 400°C was found to follow the equations V/sub calc/ = $7.0 \cdot 10^{-4}$ T(°C) + 36.95 and V/sub dol/ = $6.9 \cdot 10^{-4}$ T(°C) + 32.24, V: cm^3/mol. Therefore calcite and dolomite cannot serve as a temperature indicator. To have an ideal geothermometer a mineral pair with high and low thermal expansion is required. Literature data demonstrate that wurtzite, sphalerite, and galena are such minerals.

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 43147

WAVE ENERGY CONVERTERS

REFER ALSO TO CITATION(S) 43147

WIND ENERGY

REFER ALSO TO CITATION(S) 42413, 42414, 43147

42602 (DOE/ET—0023/1) **Federal Wind Energy Program. Program summary.** (Department of Energy, Washington, D.C. (USA). Div. of Solar Technology). Jan 1978. 78p. Dep. NTIS, PC A05/MF A01.

The objective of the Federal Wind Energy Program is to accelerate the development of reliable and economically viable wind energy systems and enable the earliest possible commercialization of wind power. To achieve this objective for small and large wind systems requires advancing the technology, developing a sound industrial technology base, and addressing the non-technological issues which could deter the use of wind energy. This summary report outlines the projects being supported by the program through FY 1977 toward the achievement of these goals. It also outlines the program's general organization and specific program elements.

AVAILABILITY (CLIMATOLOGY)

42603 (PNL—2519) **Semi-annual report of the Wind Characteristics Program Element for the period July 1977 through December 1977.** Elderkin, C.E.; Wendell, L.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 98p. Dep. NTIS, PC A05/MF A01.

Within the Federal Wind Energy Program, the Wind Characteristics Program Element (WCPE) is a service element established to provide the appropriate wind characteristics information to those involved in energy program planning, design and evaluation of wind energy conversion systems (WECS), selection of sites for the installation of WECS, and the operation of WECS. The program contributions are to consist of reliable estimates of wind characteristics pertinent to WECS design, effective analyses and methods for the determination of wind energy potential over large areas, dependable and cost-effective methodologies for the siting of WECS, and descriptions of the day-to-day variability and predictability of wind energy for WECS operations. To accomplish these goals, the WCPE has been divided into four technical program areas: wind characteristics for design and performance evaluation; mesoscale wind characteristics; development of siting methodologies; and wind characteristics for WECS operations.

REGULATIONS

42604 (PB—273006) **Legal-institutional implications of Wind Energy Conversion Systems (WECS). Executive summary report.** (George Washington Univ., Washington, D.C. (USA). Program of Policy Studies in Science and Technology). Sep 1977. 39p. NTIS PC A03/MF A01.

The legal issues presented by wind energy conversion systems (WECS) utilization are often closely related to its structural and technological features, as well as to its economic and social implications. Some information about wind systems, their likely applications and problems, are briefly stated. The features of the existing legal structure which may facilitate the implementation of such systems are noted. The authors summarize the ways in which the legal situation varies with particular applications and which applications pose the greatest legal difficulties. The complex subject of offshore wind systems is discussed.

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 42613

APPLICATIONS

42605 (UM-WF-TR—76-10) **Design and installation of heating system for UMass Solar Habitat I.** Wells, W.D.; McGowan, J.G. (Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering). Dec 1976. Contract EG-76-S-04-2365. 102p. Dep. NTIS, PC A06/MF A01.

Details are presented of design principles and installation of the solar and windpowered heating systems installed in UMass Solar Habitat I. Included are a complete specification of materials and operating instructions. A summary of potential modifications and improvements to the system is also included.

TURBINE DESIGN AND OPERATION

42606 (COO—2698-2) **1976 Energy Resource Alternatives II Competition. Final report.** McGill, R.A.; Iannucilli, M.; Marshal, J.; Sununu, J.H.; Eschbach, J.E.; Anson, J.; Wark, D.; Stock, D.E. (SCORE, Inc., Cambridge, Mass. (USA)). Oct 1977. Contract EY-76-C-02-2698. 260p. Dep. NTIS, PC A12/MF A01.

Descriptions of all the entries in the competition are presented. Competition rules and judging procedures are described. Entries consisted of team efforts from colleges and universities. The competition called for the student teams to develop means for producing electrical power sufficient to meet the needs of a single family home, using an energy source other than oil or natural gas. The electric power produced had to be economically realistic when compared to present energy sources.

42607 (DOE/NASA/1028—78/16) **Comparison of computer codes for calculating dynamic loads in wind turbines.** Spera, D.A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1977. Contract EX-76-A-29-1028. 40p. (NASA-TM—73773; CONF-770921—7). Dep. NTIS, PC A03/MF A01.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

Seven computer codes for analyzing performance and loads in large, horizontal-axis wind turbines were used to calculate blade bending moment loads for two operational conditions of the 100 kW Mod-O wind turbine. Results are compared with test data on the basis of cyclic loads, peak loads, and harmonic contents. Four of the seven codes include rotor-tower interaction and three are limited to rotor analysis. With a few exceptions, all calculated loads were within 25% of nominal test data.

42608 (DOE/NASA/1028—78/17) **Wake characteristics of a tower for the DOE—NASA MOD-1 wind turbine.** Savino, J.M.; Wagner, L.H.; Nash, M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1978. Contract EX-76-A-29-1028. 77p. (NASA-TM—78853). Dep. NTIS, PC A05/MF A01.

A $^1/_{40}$th-scale model of a tower concept designed for the DOE-NASA MOD-1 wind power turbine was tested in a low-speed wind tunnel to determine the flow characteristics in the wake downwind of the tower. The tower model is a four-leg lattice type structure constructed with round members and gusset plates at the intersections of the members. Wind speed profiles were determined in a fixed plane downstream of the tower. Local values of wake minimum velocity ratio, average velocity ratio, and width were determined from these profiles, and these quantities were presented as a function of tower elevation for six wind approach angles form 0° to 45°. The results from the MOD-1 tower model were compared to those of a MOD-O tower model (also a four-leg lattice configuration, but without gusset plates) and an eight-leg model previously reported. All three towers were constructed with round members. The comparison was based on single mean values of ratio of average velocity defect to free-stream velocity and ratio of wake thickness to blade radius.

42609 (SAND—78-0577) **Torque ripple in a vertical axis wind turbine.** Reuter, R.C. Jr.; Worstell, M.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 45p. Dep. NTIS, PC A03/MF A01.

Torque ripple is a name given to time variations in torque which are propagated through the drive train of wind energy conversion systems. An analytical and experimental investigation of torque ripple in a Darrieus vertical axis wind turbine is presented. An analytical model of the turbine is described and numerical results from a solution to the equations of this model are compared to experimental results obtained from the existing DOE/Sandia 17 meter vertical axis wind turbine. Discussions on the sources of torque ripple, theoretical and experimental correlation, and means of suppressing its magnitude are included.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 42609

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 42603

42610 (RLO—2227-T24-77/2) **Vegetation as an indicator of high wind velocity: Phase I. Final report.** Hewson, E.W.; Wade, J.E.; Baker, R.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Jul 1977. Contract EY-76-S-06-2227-024. 68p. Dep. NTIS, PC A04/MF A01.

The objective of this study is to develop methods of using wind deformed vegetation for the selection of optimum sites for utilization of wind energy. Five different indices of wind effects on trees have been developed and are presently being calibrated in terms of various wind characteristics. In addition wind shaped coastal shrubs are being investigated as indicators of persistent strong winds. Field studies are presently being conducted in the Columbia Gorge and in western Oregon. Considerable effort has been devoted to the development of a complete reference list concerned with wind deformed vegetation. Particularly useful references have been abstracted and presented in an Appendix.

ELECTRIC POWER ENGINEERING

42611 **CEGB statistical yearbook 1976—1977.** London; Central Electricity Generating Board (1977). 20p.

Report presents statistics covering power stations, generation and transmission in England and Wales.

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 42934, 43134, 43135, 43137, 43191, 43192

42612 (FE—2455-77-4) **Conceptual design of an atmospheric fluidized-bed combustion electric power generating plant. Quarterly technical progress report, October—December 1977.** Cosgrove, E.J. (Burns and Roe, Inc., Woodbury, N.Y. (USA)). Jan 1978. Contract EF-77-C-01-2455. 23p. Dep. NTIS, PC A02/MF A01.

Progress is reported in a program whose objective is to prepare a conceptual design for a nominal 600 MW electric power generating plant that will directly combust non-compliance western coal in an atmospheric fluidized-bed boiler and generate electric power in an environmentally acceptable manner. The scope of work of this program is to perform all services to prepare a conceptual design in sufficient detail to describe and estimate cost and economics for an atmospheric fluidized-bed combustion (AFBC) electric power generating plant, and to optimize the production of electric power and any by-products from coal. As a minimum, the work shall produce a conceptual design, drawings, outline specifications, capital and operating cost estimates and documentation of all related analyses, calculations and studies for the commercial size plant. Of particular importance is the recommendation and conceptual design for scale down of the commercial plant to a size that will demonstrate the feasibility of the selected process.

42613 Study on the concentration difference energy system. Isshiki, N. (Tokyo Inst. of Tech.). *J. Non-Equilib. Thermodyn.;* 2: No. 2, 85-107(1977).

A theoretical and conceptional investigation and proposal of a special energy system are discussed. The system utilizes the concentration difference of mainly aqueous solutions, which have been used in absorption refrigeration before. It is hoped that this energy system will be used widely in general heating, power generation, propulsion, and energy storage. Theoretical consideration is given to the study and examination of the above possibilities. The many suggestions proposed here are thought to be of importance for thermal engineering and for energy engineering in the future.

42614 List of CEGB bibliographies. London; Central Electricity Generating Board (1977). 37p.

Report lists about 300 bibliographies covering many aspects of power generation and transmission.

42615 Report and accounts for the year ended 31 March 1977. London; Central Electricity Generating Board (1977). 60p.

Report reviews the activities of the Board for the year: the profit after interest was 129.8m pounds; total sales of electricity were 204.661 TWh with a maximum demand of 42110 MW. System thermal efficiency was 31.59%. 72% of the Board's energy supplies were provided by coal.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

42616 (MIT-EL—77-002(Vol.1)) **Advanced wet—dry cooling tower concept performance prediction.** Snyder, T.; Bently, J.; Giebler, M.; Glicksman, L.R.; Rohsenow, W.M. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jan 1977. Contract EY-76-S-02-2500. 162p. Dep. NTIS, PC A08/MF A01.

The purpose of this years' work has been to test and analyze the new dry cooling tower surface previously developed. The model heat transfer test apparatus built last year has been instrumented for temperature, humidity and flow measurement and performance has been measured under a variety of operating conditions. Tower tests showed approximately 40 to 50% of the total energy transfer as taking place due to evaporation. This can be compared to approximately 80 to 85% for a conventional wet cooling tower. Comparison of the model tower test results with those of a computer simulation has demonstrated the validity of that simulation and its use as a design tool. Computer predictions have been made for a full-size tower system operating at several locations. Experience with this counterflow model tower has suggested that several design problems may be avoided by blowing the cooling air horizontally through the packing section. This crossflow concept was built from the previous counterflow apparatus and included the design and fabrication of new packing plates. Instrumentation and testing of the counterflow model produced data with an average experimental error of 10%. These results were compared to the predictions of a computer model written for the crossflow configuration. In 14 test runs the predicted total heat transfer differed from the measured total heat transfer by no more than 8% with most runs coming well within 5%. With the computer analogy's validity established, it may now be used to help predict the performance of fullscale wet-dry towers.

42617 (PB—272965) **Conceptual review and preliminary design of multifarious water intake structure. Final report.** Goodman, A.S. (Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Civil and Environmental Engineering). Aug 1977. 159p. NTIS PC A08/MF A01.

This report presents planning analyses and preliminary design drawings for a multifarious water intake structure (MWIS), the designation implying many kinds of parts or elements. The present report emphasizes engineering feasibility. Layout and operating details of the MWIS are for an intake serving a 350-550 MW thermal power generating unit located on an estuary. The approximate cost of the MWIS would be $12 million. The principal design features are: adjustable louvers to act as a behavioral barrier to fish; curtain walls in front of the screens to provide for selective water admission to reduce impingement of aquatic organisms; horizontal traveling screens which move in the direction and speed of ambient water flow to guide fish and reduce the degree of impingement; and fish handling facilities to convey organisms back to their natural environment. The intake, as a whole, is a major departure from the current state-of-the-art of intake design.

42618 (PB—274816) **Theoretical study of the earthquake response of the Paradise cooling tower.** Yang, T.Y.; Gran, C.S.; Bogdanoff, J.L. (Purdue Univ., Lafayette, Ind. (USA). School of Aeronautics and Astronautics). 3 Jun 1976. 81p. NTIS PC A05/MF A01.

A detailed dynamic analysis, presented in a series of reports, was conducted on the seismic response and structural safety of key subsystems (steam generator, high pressure steam piping, coal handling equipment, cooling tower, chimney) of Unit no. 3 of TVA at Paradise, Kentucky in order to: (1) determine for the key components the natural frequencies below 50 Hz and the corresponding normal modes; (2) determine response of plant to seismic disturbances; (3) verify through full scale tests results obtained in (1) and determine estimates of damping needed in (2); (4) determine potential failure modes of major structural components; and (5) determine a spare parts policy for a power system so that outages due to damage from seismic disturbances are minimal. Analytical and experimental methods are used. In this study, the dynamic behavior of the cooling tower is analyzed, using quadrilateral plate and beam elements oriented arbitrarily in space, following analysis and confirmation of their predictive value. Response to 1940 El Centro earthquake parameters is studied, and assumed viscous damping coefficients are considered. Comprehensive results, based on this response, are given.

POWER CYCLES

42619 (EPRI-EM—696(Vol.2)) **Assessment of the role of advanced technologies in small utilities. Final report.** Steitz, P.; Mayo, G. (Burns and McDonnell Engineering Co., Kansas City, Mo. (USA)). May 1978. 173p. Dep. NTIS, PC A08/MF A01.

Research and development efforts are currently being pursued for a number of advanced power generation technologies which have a potential for contributing to the national energy situation. This study assessed the potential role of six such advanced technologies in small municipal and rural electric utility systems by comparing the economics of utilizing these advanced technologies with the economics of conventional generation types. The technologies examined included: a 5-MW coal-fired diesel engine; a 5-MW coal-fired closed-cycle combustion turbine; a 2-MW coal-fired Stirling engine; a 2-MW oil-fired Stirling engine; a 1-MW organic Rankine cycle bottoming on a 5-MW diesel engine; and a 1-MW two-phase engine bottoming on a 5-MW diesel engine. The results of the study indicate that if the characteristics assumed for these technologies can be achieved then: The oil-fired technologies (oil-fired Stirling engine, organic Rankine cycle/diesel, and two-phase engine/diesel) could penetrate a significant portion of the future small utility market. They will most likely be employed as intermediate duty generators and their actual ability to penetrate the market will depend on their actual selling price and heat rate. If the heat rates projected herein are achieved significant market penetration could be realized at capital costs of $250 to $300 per kilowatt in 1975 dollars. The coal-fired technologies (coal-fired diesel, closed-cycle combustion turbine, and coal-fired Stirling engine) are not competitive with base load capacity from joint action projects but may be competitive with purchased base load capacity. Specifically, the coal-fired diesel has the lowest break-even capital cost and even allowing for the uncertainties of operation and maintenance costs would be only marginally attractive at a cost above $500/kW. The coal-fired combustion turbine and the coal-fired Stirling engine could be attractive at costs below $450/kW and $650/kW respectively.

42620 (ORNL/TM—6041) **Design study of a 200 MW(e) alkali metal/steam binary power plant using a coal-fired fluidized bed furnace.** Samuels, G.; Graves, R.L.; Lackey, M.E.; Tudor, J.J.; Zimmerman, G.P. (Oak Ridge National Lab., Tenn. (USA)). Apr 1978. Contract W-7405-ENG-26. 229p. Dep. NTIS, PC A11/MF A01.

The results of a study of 200 MW(e) alkali metal/steam binary power plant using a coal-fired fluidized bed furnace are described. Both cesium and potassium were evaluated for the topping cycle working fluid and cesium was selected. The fuel used was Illinois No. 6 coal, and limestone was used as the bed sorbent material. For the reference design, the furnace operated at atmospheric pressure and the cycle conditions for the power conversion system were 1500°F to 900°F for the topping cycle and 2400 psi 1000°F to 1½ in. Hg for the steam system. Several variations of the plant were briefly evaluated. These variations included using a supercritical steam system and using a pressurized furnace. The principal conclu-

sions of the study are as follows: a satisfactory design of an atmospheric pressure fluidized bed furnace binary power plant was evolved which uses a variation of the conventional binary cycle which permits utilizing the full potential of the alkali metal topping cycle; the net plant efficiency (coal to busbar) of the reference system was 44.6%; the net plant efficiency of a larger system with a 3500 psi 1000°F steam system was 46.8%; an intermediate pressure turbocharged system with a furnace pressure of 4 atm (0.4 MPa) would have many advantages in comparison to the atmospheric pressure system, including a plant efficiency about one percentage point higher than the reference design, reduced limestone requirement and potential capital cost saving; and although cost estimates were not a part of the design study, a comparison of the design of this study to that of the Energy Conversion Alternative Study (ECAS) indicates plant costs 20 to 25% less than that of the final ECAS design.

42621 Coal fuels the U.S. gas turbine programme to bridge energy gap. Butler, P. *Engineer (London);* **246**: No. 6369, 32-33, 36(20 Apr 1978).

Research programs in the USA aimed at the development of commercial size gas turbines by 1990 for using coal-derived fuels are discussed. These programs also include studies of coal gasification, fluidized-bed combustors, and combined-cycle power plants. The economics, environmental aspects, and current status of these programs are reviewed. Two foreign projects on coal-fueled combined cycles are mentioned. It is concluded that the early 1980's will be a crucial testing time for the new breed of coal-fueled combined-cycle power plants. (LCL)

WASTE-FUELED SYSTEMS

42622 (PB—274552) **Evaluation of the Ames Solid Waste Recovery System. Part I. Summary of environmental emissions: equipment, facilities, and economic evaluations. Interim report 5 Feb 76—4 Feb 77.** Even, J.C.; Adams, S.K.; Gheresus, P.; Fiscus, D.E.; Romine, C.A. (Ames, City of, Iowa (USA); Midwest Research Inst., Kansas City, Mo. (USA); Iowa State Univ. of Science and Technology, Ames (USA); Ames Lab., Iowa (USA)). Nov 1977. 216p. NTIS PC A10/MF A01.

The following topics are discussed: characterization of the refuse derived fuel (RDF) produced; Equipment and plant performance evaluations; an analysis of plant maintenance and manpower requirements; and an analysis of plant operating costs. Also included is a brief summary of the boiler environmental emissions and boiler performance when mixtures of coal and RDF are burned. During the year the plant processed 37,136 Mg of municipal solid waste. Average as received heating value of the RDF produced was 13,050 kJ/kg at 23.0% moisture and 17.4% ash. The net cost of operating the refuse processing plant after credits were given for the RDF, recovered metals and dump fees was $18.90/Mg of municipal solid waste received. The economic model of the plant showed that a volume increase is the most attractive method of reducing the net cost.

COMPONENTS

REFER ALSO TO CITATION(S) 42621, 43232

42623 (EPRI-NP—744) **Nondestructive evaluation of steam turbine rotors: an analysis of the systems and techniques utilized for in-service inspection. Interim report.** Golis, M.J.; Brown, S.D. (Battelle Columbus Labs., Ohio (USA)). Apr 1978. 74p. Dep. NTIS, PC A04/MF A01.

The discontinuities present in large steam turbine rotor forgings and their growth during service are of major concern since failures of these rotors are extremely expensive both in potential loss of lives and revenues. The current inservice inspections of these rotors are thus a significant part of the quality control programs of electric utilities to assure the safe and continued operation of power generating stations. The nature of the NDE processes now being used for rotor inspection and the types of internal indications which are considered technically relevant, from a stress distribution viewpoint are reviewed, and recommendations are made of where rotor examinations can be improved. In particular, the details of boresonic examination procedures are reviewed and the most probable causes of routine inspection uncertainties are identified. Minimum flaw sensitivities are described and the probabilities of detection, based on boresonic axial scan patterns are identified in terms of the measured beam profiles of typical inspection transducers. A set of acceptance criteria to be used with existing inspection systems are suggested. These criteria would require inspection service contractors to demonstrate their system's minimum sensitivity, ultimate depth and spatial resolution, and repeatability by virtue of an ability to repeatedly detect and discriminate between sets of precision holes placed in specified patterns within a recommended universal calibration standard.

42624 (PB—274820) **Theoretical study on earthquake response of a reinforced concrete chimney.** Yang, T.Y.; Shiau, L.C.; Lo, H. (Purdue Univ., Lafayette, Ind. (USA). School of Aeronautics and Astronautics). 3 Jun 1976. 96p. NTIS PC A05/MF A01.

A detailed dynamic analysis, presented in a series of reports, was conducted on the seismic response and structural safety of key subsystems (steam generator, high pressure steam piping, coal handling equipment, cooling tower, chimney) of Unit no. 3 of TVA at Paradise, Kentucky in order to: (1) determine for the key components the natural frequencies below 50 Hz and the corresponding normal modes; (2) determine response of plant to seismic disturbances; (3) verify through full scale tests results obtained in (1) and determine estimates of damping needed in (2); (4) determine potential failure modes of major structural components; and (5) determine a spare parts policy for a power system so that outages due to damage from seismic disturbances are minimal. Analytical and experimental methods are used. Here, the chimney is modeled and its dynamic responses analyzed by modal superposition. Three assumed values of damping coefficients are applied to its two reinforced concrete shells, yielding data for various stress areas after application of 1940 El Centro earthquake parameters. Stress distribution around flue openings at the worst time is determined from quadrilateral sheet finite element data.

42625 (PB—274822) **Coal handling equipment.** Kayser, K.W.; Euler, J.A. (Purdue Univ., Lafayette, Ind. (USA). School of Aeronautics and Astronautics). 3 Jun 1976. 40p. NTIS PC A03/MF A01.

A detailed dynamic analysis, presented in a series of reports, was conducted on the seismic response and structural safety of key subsystems (steam generator, high pressure steam piping, coal handling equipment, cooling tower, chimney) of Unit no. 3 of TVA at Paradise, Kentucky in order to: (1) determine for the key components the natural frequencies below 50 Hz and the corresponding normal modes; (2) determine response of plant to seismic disturbances; (3) verify through full scale tests results obtained in (1) and determine estimates of damping needed in (2); (4) determine potential failure modes of major structural components; and (5) determine a spare parts policy for a power system so that outages due to damage from seismic disturbances are minimal. Analytical and experimental methods are used. Two elevated coal conveyors are modeled, using simple beams with appropriate static properties. The dynamic characteristics of the models, their natural frequencies, and mode shapes were found by using the finite element approach, and responses determined by modal analysis. Results are shown in linear and tabular form, based on application of stresses equal to those of the 1940 El Centro earthquake.

42626 (PB—274926) **Simple continuum model for dynamic analysis of complex plane frame structures.** Sun, C.T.; Lo, H.; Cheng, N.C.; Bogdanoff, J.L. (Purdue Univ., Lafayette, Ind. (USA). School of Aeronautics and Astronautics). 3 Jun 1976. 30p. NTIS PC A03/MF A01.

A detailed dynamic analysis, reported in this series, was conducted on the seismic response and structural safety of key subsystems (steam generator, high pressure steam piping, coal handling equipment, cooling tower, chimney) of Unit no. 3 of TVA at Paradise, Kentucky in order to: (1) determine for the key components the natural frequencies below 50 Hz and the corresponding normal modes; (2) determine response of plant to seismic disturbances; (3) verify through full scale tests results obtained in (1) and determine estimates of damping needed in (2); (4) determine potential failure modes of major structural components; and (5) determine a spare parts policy for a power system so that outages due to damage from seismic disturbances are minimal. Analytical and experimental methods are used. This volume includes discussion of a simple model developed for dynamic analysis of large frame structures that can account both for joint rotation and axial deformation. The governing equations are derived from a continuum theory for gridworks. Natural frequencies are computed by using the simple model and by finite element method. Comparisons of the solutions show that the simple model yields reasonable solutions for the first five modes.

42627 (PB—274935) **A Timoshenko beam model for vibration of plane frames.** Sun, C.T.; Chen, C.C.; Bogdanoff, J.L.; Lo, H. (Purdue Univ., Lafayette, Ind. (USA). School of Aeronautics and Astronautics). 3 Jun 1976. 42p. NTIS PC A03/MF A01.

A detailed dynamic analysis, reported in this series, was conducted on the seismic response and structural safety of key subsystems (steam generator, high pressure steam piping, coal handling equipment, cooling tower, chimney) of Unit no. 3 of TVA at Paradise, Kentucky in order to: (1) determine for the key components the natural frequencies below 50 Hz and the corresponding normal modes; (2) determine response of plant to seismic disturbances; (3) verify through full scale tests results obtained in (1) and determine estimates of damping needed in (2); (4) determine potential failure modes of major structural components; and (5) determine a spare parts policy for a power system so that outages due to damage from seismic disturbances are minimal. Analytical and experimental

methods are used. This volume includes discussion of the use of the Timoshenko beam model with bending and shear rigidities evaluated by a procedure that takes the joint rotation into account in a quasi-static manner. Explicit formulas for bending and shear rigidities of the model are derived in terms of the member dimensions and material properties of the original frame structure. A shear beam model is derived from the Timoshenko beam model. Solutions for three evaluative examples are presented and compared with exact finite element solutions.

42628 (TID—28145) **Evaluation of corrosion rates and metallurgical stability of boiler components: 30 MW multicell fluidized-bed boiler at Rivesville, West Virginia. Executive summary.** (Gilbert/Commonwealth, Reading, Pa. (USA)). 15 Mar 1977. Contract EX-76-C-01-2228. 63p. Dep. NTIS, PC A04/MF A01.

The corrosion rates and metallurgical stability of certain components in the Rivesville 30 MW Multicell Fluidized Bed (MFB) boiler and auxiliary equipment are evaluated. There was concern within the Energy Research and Development Administration (ERDA) as to the durability and integrity of this facility because of a lack of experience with these materials under the conditions of required operation. Corrosion rates are estimated and the conformance of the tube design to the ASME code is verified. It has been found that the bulk of the tubes in the boiler appear to be within the ASME code limit for the life of the plant--designed for 85,000 hours. However, in one case, defined as the "worst case" tube at the primary superheater outlet, the tube wall may thin down to the minimum ASME code required thickness after 10,000 hours. Because of the safety factor incorporated in the ASME code, the tube may continue to operate after that for a considerable number of hours, but no estimate can presently be made. Likewise, some components of the ladder may corrode heavily. The designated components must, therefore, be monitored. Not enough information is available about the ash removal system to recommend immediate action. It is suggested that the ash removal system be examined frequently and a detailed alternate program be submitted as a contingency. An experimental program for estimate of corrosion rates is essential for the next design stages of larger FB Boilers, and an outline for such a program is proposed. An outline for a quality assurance program for future FB boiler design, construction and operation is also proposed.

42629 **Slow-speed diesel power plants.** Guery, R.; Schlachter, H.P. *Diesel Eng.;* **74**: No. 796, 21-22, 24, 18(Spr 1978).

Due to its basic design, the slow-speed diesel has much fewer moving parts than the medium-speed diesel, and thus naturally higher reliability. Operating statistics indicate that while diesel engines may be subject to a greater number of non-scheduled stoppages than steam turbines, the duration of any problem with the diesel is usually much shorter. The net result is that total down time of the diesel is considerably shorter than that of the steam turbine. Another important feature with the diesel is that with regular maintenance, its initial operational characteristics (fuel consumption, lubricating oil consumption, etc.) can easily be reinstated. High availability at full load, together with excellent fuel economy, make the slow-speed diesel the most economical solution for power generating in its range. It is well suited to heavy-duty, sustained operation and has an outstanding record in base load applications. Slow-speed diesels have minimal environmental impact and can meet stringent pollution standards. The exhaust of these engines is almost colorless, with complete absence of fly ash.

42630 **Investigation of burnout under transient hydrodynamic conditions.** Smirnov, O.K.; Zaitsev, V.N.; Serov, E.E. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 5, 72-74(1978).

Translated from Teploenergetika; 24: No. 5, 81-83(1977).

Investigations of burnout in transient processes have been developed in connection with the closer attention paid to evaluation of the consequences of failures of equipment. The conditions of onset of burnout and variation with time in thermal conditions of the heating surface with decrease in water flowrate are discussed. The influence of unsteadiness of operational conditions is determined by direct comparison of the boundary parameters of burnout and of coefficients of heat transfer in the zone of deteriorated heat transfer, obtained by experiment under dynamic and static conditions.

ECONOMICS

REFER ALSO TO CITATION(S) 42449, 43136, 43142

42631 (PB—273314) **Capital cost: high and low sulfur coal plants - 1200 MWe. Volume 1.** (United Engineers and Constructors, Philadelphia, Pa. (USA). Advanced Engineering Dept.). Oct 1977. Contracts AT(49-24)-0351;ERDA-EY-76-C-02-2477. 381p. NTIS PC A17/MF A01.

The study develops and provides the total base construction cost for a 1200 MWe (Nominal) high sulfur coal plant and a 1200 MWe (noninal) low sulfur coal plant. The 1200 MWe coal plant cost estimates are based on generic plant designs at a hypothetical site. The principle technical features of the plants, however, are based on several constructed plants of this size located in different sections of the country. The capital cost estimate is presented in detail in Volumes I and II for the high sulfur coal plant. This capital cost estimate was modified for the low sulfur coal plant and is printed in an abbreviated form in Volume III. This study, together with the companion study for the 800 MWe low and high sulfur plants, also represents an update of WASH-1230 Volume III published in 1972 by the Atomic Energy Commission.

42632 (PB—273315) **Capital cost: high and low sulfur coal plants - 1200 MWe. Volume 2.** (United Engineers and Constructors, Philadelphia, Pa. (USA). Advanced Engineering Dept.). Oct 1977. Contracts AT(49-24)-0351;ERDA-EY-76-C-02-2477. 317p. NTIS PC A14/MF A01.

The study develops and provides the total base construction cost for a 1200 MWe (nominal) high sulfur coal plant and a 1200 MWe (nominal) low sulfur coal plant. The 1200 MWe coal plant cost estimates are based on generic plant designs at a hypothetical site. The principle technical features of the plants, however, are based on several constructed plants of this size located in different sections of the country. The capital cost estimate is presented in detail in Volumes I and II for the high sulfur coal plant. This capital cost estimate was modified for the low sulfur coal plant and is printed in an abbreviated form in Volume III. This study, together with the companion study for the 800 MWe low and high sulfur plants, also represents an update of WASH-1230 Volume III published in 1972 by the Atomic Energy Commission. (Portions of this document are not fully legible)

42633 (PB—273316) **Capital cost: high and low sulfur coal plants - 1200 MWe. Volume 3.** (United Engineers and Constructors, Philadelphia, Pa. (USA). Advanced Engineering Dept.). Oct 1977. Contracts AT(49-24)-1351;ERDA-EY-76-C-02-2477. 280p. NTIS PC A13/MF A01.

The study develops and provides the total base construction cost for a 1200 MWe (nominal) high sulfur coal plant and a 1200 MWe (nominal) low sulfur coal plant. The 1200 MWe coal plant cost estimates are based on generic plant designs at a hypothetical site. The principle technical features of the plants, however, are based on several constructed plants of this size located in different sections of the country. The capital cost estimate is presented in detail in Volumes I and II for the high sulfur coal plant. This capital cost estimate was modified for the low sulfur coal plant and is printed in an abbreviated form in Volume III. This study, together with the companion study for the 800 MWe low and high sulfur plants, also represents an update of WASH-1230 Volume III published in 1972 by the Atomic Energy Commission.

42634 **Effects of system loads on optimal load flow solutions.** Murty, P.S.R. (Osmania Univ., Hyderabad, India). *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 150-154(Dec 1977).

Several techniques are available for optimizing the hourly generating costs of a predominant thermal system. All methods assume that bus voltage magnitudes and phase angles can both be taken as variables for optimization. However, in cases where the system composite loads are dependent on voltage magnitudes and also the voltage regulation at the low voltage consumer buses is not 100 percent, the effect of the static load characteristics cannot be neglected. Also from the point of view of equivalent loads lumped at a relatively small number of major buses connected to hundreds of radial lines the inclusion of voltage dependent load model is unavoidable. Thus, the saving that can be achieved by optimization is not as high as can be expected when powers at load buses are sensitive to voltage variations. The method of Lagrange multipliers is used for illustrating the above facts.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 43102

42635 (N—78-11499) **Formation of stored heat by means of bled steam during times of load reduction and its use in peak load times.** Bitterlich, E. Translated from *Tech. Mitt.;* **60**: No. 9/10, vp(Sep-Oct 1976). 42p. (NASA-TM—75147). NTIS PC A03/MF A01.

Technical possibilities and economic advantages of integrating hot water storage systems into power plants fired with fossil fuels are discussed. The systems can be charged during times of load reduction and then used for back-up during peak load periods. Investment costs are higher for such systems than for gas turbine power plants fired with natural gas or light oil installed to meet peak load demand. However, by improving specific heat consumption by about 1,000 kcal/k ohm, which thus reduces the related costs, investment costs will be compensated for, so that power production costs will not increase.

FUELS

REFER ALSO TO CITATION(S) 43486

42636 (NUS—1819) **Review of draft environmental assessment reports for round I coal conversion candidates at twenty-five generating stations.** Coffey, M.E.; Andes, R. (NUS Corp., Rockville, Md. (USA)). Dec 1976. 39p. Dep. NTIS, PC A03/MF A01.

The air quality sections of the environmental assessments performed by Energy and Environmental Analysis Inc. (EEA) for 25 generating stations, having one or more units as Round I coal conversion candidates, were reviewed and revised, where appropriate, by NUS for the FEA. The review/revision process was to provide a supplemental analysis as necessary rather than to provide a complete reanalysis of the expected air quality impact of the coal conversion of each candidate unit. In all cases, the rationale behind the suggested revision is presented for the benefit of those FEA personnel who will have to decide on the content of the final environmental assessment report.

ENVIRONMENTAL ASPECTS

42637 (FEA/G—77/113) **Environmental impact determination of action to be taken under the Energy Supply and Environmental Coordination Act for powerplant 2, Weston Generating Station, Marathon County, Wisconsin.** (Federal Energy Administration, Washington, D.C. (USA)). Apr 1977. 122p. Dep. NTIS, PC A06/MF A01.

On June 30, 1975 the Federal Energy Administration (FEA) issued prohibition orders to the Wisconsin Public Service Corp. which, if made effective would prohibit the burning of petroleum products or natural gas as the primary energy source for power plant 2 at the Weston Generating Station. Power plant 2 currently burns natural gas and coal. The probable ultimate results of making effective these prohibition orders would be to convert these power plants to 100 percent coal firing. The Environmental Assessment of the proposed action at the Weston Station was thoroughly reviewed and the potential environmental impacts of converting to 100 percent coal firing were as follows. The principal air quality impacts are increased emissions of particulate matter and SO_2, but air concentrations of both will be well below Federal and state air quality standards. Other air pollutants are not expected to have an impact on ambient air quality. No new water pollutant criteria are expected to be violated by the fuel conversion. No impacts on aquatic habitats would result. No endangered or threatened species are known to occur in the generating station site area. No historic sites would be affected. Based on this environmental assessment, FEA has determined that the issuance of a Notice of Effectiveness to Weston Generating Station, power plant 2, will not significantly affect the quality of the human environment within the National Environmental Policy Act, and FEA will prepare a negative determination on the issuance of the Notice of Effectiveness to the Weston Generating Station certifying that this action is not "a Federal action significantly affecting the quality of the human environment" and does not require preparation of an environmental impact states pursuant to the NEPA. (LCL)

42638 (FEA/G—77-150) **Environmental impact determination of action to be taken under the Energy Supply and Environmental Coordination Act for powerplants 3, 4, and 5, Lawrence Generating Station, Lawrence, Kansas.** (Federal Energy Administration, Washington, D.C. (USA)). May 1977. 106p. Dep. NTIS, PC A06/MF A01.

On June 30, 1975 the Federal Energy Administration (FEA) issued prohibition orders to the Kansas Electric and Power Co. which, if made effective would prohibit the burning of petroleum products or natural gas as the primary energy source for power plants 3, 4, and 5 at the Lawrence Generating Station. Power plants 3, 4, and 5 currently burn natural gas or oil. The probable ultimate results of making effective these prohibition orders would be to convert these power plants to 100 percent coal firing. The Environmental Assessment of the proposed action at the Lawrence Station was thoroughly reviewed and the potential environmental impacts of converting to 100 percent coal firing were as follows. The principal air quality impacts are increased emissions of particulate matter and SO_2, but air concentrations of both will be well below Federal and state air quality standards. Other air pollutants are not expected to have an impact on ambient air quality. No new water pollutant criteria are expected to be violated by the fuel conversion. No new impacts on aquatic habitats would result. No historic sites would be affected. Based on this environmental assessment, FEA has determined that the issuance of a Notice of Effectiveness to Lawrence Generating Station, power plants 3, 4, and 5, will not significantly affect the quality of the human environment within the National Environmental Policy Act, and FEA will prepare a negative determination on the issuance of the Notice of Effectiveness to the Lawrence Generating Station certifying that this action is not "a Federal action significantly affecting the quality of the human environment" and does not require preparation of an environmental impact states pursuant to the NEPA. (LCL)

42639 (FEA-G—77-151) **Environmental impact determination of action to be taken under the Energy Supply and Environmental Coordination Act for powerplants 1 and 2, Sheldon Generating Station, Lancaster County, Nebraska.** (Federal Energy Administration, Washington, D.C. (USA)). May 1977. 98p. Dep. NTIS, PC A05/MF A01.

On June 30, 1975, the Federal Energy Administration (FEA) issued prohibition orders to the Nebraska Public Power District which, if made effective, would prohibit the burning of petroleum products or natural gas as the primary energy source for powerplants 1 and 2 at its Sheldon Generating Station. The probable ultimate result of making effective these prohibition orders would be to convert powerplants 1 and 2, Sheldon Generating Station, to 100 percent coal firing. The potential environmental impacts of converting Sheldon powerplants 1 and 2 to 100 percent coal firing are as follows. The principal air quality impacts are increased emissions of particulate matter and SO_2, but air concentrations of both will be well below Federal and state air quality standards; other air pollutants, NO_2, CO, and HC, are not expected to have an impact on ambient air quality. Surface water quality in the area would not be affected and ground water quality would not be significantly affected. No impacts on aquatic habitats would result since the station does not discharge into any surface waters. No threatened or endangered terrestrial species are known in the vicinity of the Sheldon Generating Station. No historic sites will be affected. Based upon the environmental assessment, FEA has determined that the issuance of Notices of Effectiveness to the Sheldon Generating Station, powerplants 1 and 2, will not significantly affect the quality of the human environment within the meaning of the National Environmental Policy Act, and FEA will prepare a negative determination on the issuance of Notices of Effectiveness to the Sheldon Generating Station certifying that this action is not "a major Federal action significantly affecting the quality of the human environment" and does not require preparation of an environmental impact statement pursuant to the NEPA.

42640 Method defining the necessary noise suppressing levels of the equipment during the design of power plants and transformer stations. Olechowski, T. *Energetyka;* **31**: No. 4, 165-168(Apr 1977). (In Polish).

An evaluation method of the necessary noise suppressing levels of the equipment of power plants and transformer stations, which can be used to meet the requirements of standards concerning noise protection of the environment, the plant, and station operation and repair is discussed.

42641 Assessment method of the noise suppressor application expedience on exhaust fans in power plants. Lubina, P.; Olechowski, T. *Energetyka;* **31**: No. 4, 168-172(Apr 1977). (In Polish).

A method for assessing the effectiveness of noise suppression procedures used on exhaust fans and the measurements carried out in three power plants are discussed.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 42221, 42636, 43574

42642 (EPRI-AF—568) **Technical assessment of NO/sub x/ removal processes for utility application. Final report.** Faucett, H.L.; Maxwell, J.D.; Burnett, T.A. (Tennessee Valley Authority, Muscle Shoals, Ala. (USA). Office of Agricultural and Chemical Development). Mar 1978. 426p. Dep. NTIS, PC A19/MF A01.

A state-of-the-art review of the processes currently being developed for the removal of nitrogen oxides (NO/sub x/) from power plant stack gas was conducted. Included within the 48 processes discussed in the report are: dry NO/sub x/ processes, dry simultaneous NO/sub x/-SO/sub x/ processes, wet NO/sub x/ processes, and wet simultaneous NO/sub x/-SO/sub x/ processes. The major sections in each technical evaluation for each process included detailed process description containing a simplified block flow diagram, the current status of development of the process, the raw material and utility requirements, the published economics, the technical and environmental considerations, and the overall advantages and disadvantages of the process. In addition to this review of the current NO/sub x/ flue gas treatment (FGT) technology, eight of these processes were recommended as candidates for preliminary economic analysis in the next phase of the study. The information for this report was gathered during the first half of 1977 and work was completed as of July 1977. The report was prepared by the Tennessee Valley Authority under a project cofunded by the U.S. Environmental Protection Agency and the Electric Power Research Institute.

42643 (EPRI-EM—735) **Noncatalytic NO/sub x/ removal with ammonia. Final report.** Muzio, L.J.; Arand, J.K.; Maloney, K.L. (KVB, Inc., Tustin, Calif. (USA)). Apr 1978. 124p. Dep. NTIS, MF A01.

Portions of document are illegible.

A potential approach to the control of nitric oxide in utility boilers, in addition to modification of the combustion process, is the selective homogeneous gas-phase reduction of nitric oxide with ammonia. A laboratory study at a scale of 3,000,000 Btu/hr was conducted to evaluate the applicability of ammonia injection for the reduction of nitric oxide in coal-fired power plants. Four coals (Utah bituminous, New Mexico subbituminous, Illinois bituminous, and Pittsburgh bituminous) were tested to determine levels of NO/sub x/ reductions achievable and the byproduct emissions. The primary variables investigated (in addition to coal type) were (1) the amount of ammonia injected, and (2) the temperature of the combustion products at the point of injection. The effect of the simultaneous addition of hydrogen along with ammonia on the NO/sub x/ removal process was also investigated. The results of these experiments indicated that NO reductions obtained with ammonia injection into coal-derived combustion products were similar to those obtained with natural gas firing in the same system and were comparable to those previously obtained in natural gas and oil-fired systems. On the order of 65 percent reductions in NO were obtained at an ammonia injection rate of one mole of ammonia per mole of NO. However, the temperature dependence was found to vary from coal to coal. The Navaho exhibited peak reductions at the lowest temperatures, 1720°F, while the Illinois coal showed peak reduction occurring at 1830°F. Typically, natural gas exhibited peak reductions at 1750°F. The unexplained variation in optimum process temperature with coal type indicates that evaluation testing would be prudent in situations where maximum NO/sub x/ control was desired and no previous experience was available for the coal in question.

42644 (EPRI-FP—715(Vol.1)) **Preliminary evaluation of potential NO/sub x/ control strategies for the electric power industry. Volume I. Final report.** Greenfield, S.M.; Peyton, T.O.; Anderson, G.E.; Attaway, L.D.; Hillyer, M.J.; MacBride, D.W. (Flow Resources Corp., San Rafael, Calif. (USA); Systems Applications, Inc., San Rafael, Calif. (USA)). Mar 1978. 152p. Dep. NTIS, PC A08/MF A01.

Flow Resources Corporation has conducted an investigation of strategies for the control of nitrogen oxides emitted by the electric utility industry's fossil fuel fired power plants. The study focused on assurance of meeting the current annual NO_2 primary National Ambient Air Quality Standard (100 $\mu g/m^3$) through the year 2000. It included four sets of nuclear/coal growth scenarios and three sets of assumed emission restrictions and centered on 20 "critical" Air Quality Control Regions (AQCR) chosen for their potential for being in NO_2 noncompliance during the study time period. A review was conducted of federal and state NO/sub x/ regulations and photochemical diffusion modeling (the latter done under subcontract by System Applications, Inc.) The principal conclusion of this study is that in most critical AQCRs, reduction of coal-fired power plant emissions below 0.3 lbs NO/sub x/10^6 Btu appears to offer little leverage for substantially further reducing annual ambient concentrations of NO_2. This result, however, varies between AQCRs, and may necessitate a more detailed evaluation of control strategies.

42645 (EPRI-FP—715(Vol.2)) **Preliminary evaluation of potential NO/sub x/ control strategies for the electric power industry. Volume II. Final report.** Greenfield, S.M.; Peyton, T.O.; Anderson, G.E.; Attaway, L.D.; Hillyer, M.J.; MacBride, D.W. (Flow Resources Corp., San Rafael, Calif. (USA); Systems Applications, Inc., San Rafael, Calif. (USA)). Mar 1978. 191p. Dep. NTIS, PC A09/MF A01.

Eight appendices of basic supporting information for the report on Preliminary Evaluation of Potential NO/sub x/ Control Strategies for the Electric Power Industry are presented. The first appendix presents a collection of federal, state and selected local limitations on the emissions and ambient concentration of NO_2, and a short summary of the potential for near-term changes in these limitations. It is intended to provide a dynamic summary of these regulatory constraints on the electric power industry, a basis for the strategies examined in the current report, and a starting point for the analysis envisioned for the following phase.The second appendix reviews NO/sub x/ control technologies: The third provides emission data for Air Quality Control Regions (AQCR). The remaining appendices contain information on: models used for projecting NO/sub x/ emissions and concentrations for the subject AQCRs; and basic power plants data, current and proposed, for the USA and for the AQCRs examined. (LCL)

42646 (PB—272952) **Magnesia FGD process testing on a coal-fired power plant. Final report, October 1974—August 1975.** Sommerer, D.K. (York Research Corp., Stamford, Conn. (USA)). Aug 1977. Contract EPA-68-02-1401. 256p. (Y—8479). NTIS PC A12/MF A01.

The report gives results of a field measurement program to determine the operability and reliability of the Chemico magnesium oxide venturi scrubber operating at Potomac Electric Power Company's Dickerson Generating Station, Frederick, Md. A cntinuous source-monitoring station was installed at the scrubber, complemented by a field analytical laboratory intended for the measurement and analysis of various process steeams. These facilities continuously monitored process and emission variables between October 1974 and January 1975, during August 1975. Scrubber operation was evaluated during steady-state and transient operation, the latter including startup, shutdown, and malfunctions. During the tests, the scrubber was available about 48% of the time, including all levels of operation. Approximately 80% of system availability was steady-state, with the system operating normally. The tests showed that, although scrubber availability was not ideal (due to logistics problems in supplying raw materials (MgO), and to mechanical problems mainly attributable to under-design in such areas as piping, slurry pumps, and other auxiliary equipment), the basic scrubber concept and design should meet critical criteria once these problems are remedied.

42647 (PB—274485) **High temperature particulate control with ceramic filters. Final report Jul 75—Aug 77.** Ciliberti, D.F. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). Oct 1977. Contract EPA-68-02-1887. 174p. NTIS PC A08/MF A01.

The report gives results of an assessment of using ceramic materials as filters for fine particulate removal at high temperatures. The program was in two phases. Phase I, directed toward the development of a porous alumina membrane filter, had limited success because of the fragility of the membranes formed, and the difficulty in controlling the pore size distribution of the filters. The major objective of Phase II, concentrating on screening other available materials, was to identify materials with good filtration potential, select one or two of the most promising, and (as rapidly as possible) demonstrate them as hot gas fine particle filters in a several hundred cu^3/hr hot test. Initial screening indicated that the most promising was a thin-walled, ceramic, cross-flow monolith, originally produced as a catalyst support for automotive exhaust systems. Screening tests indicated the possibility of virtually 100% removal of even submicron limestone test dust at face velocities and pressure drops not dissimilar from those typical of fabric filtration. Later bench scale tests at around 1000 K confirmed the material's ability to perform well at high temperatures. Final testing, at a larger facility where flows of 4.8 cu^3/min at 950°K were achieved, indicated that this ceramic configuration offers great potential as a hot gas filter.

42648 **Main laws and approximate calculations for the formation of oxides of nitrogen when burning oil in boilers.** Tager, S.A.; Kalmaru, A.M. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 5, 46-53(1978).

Translated from Teploenergetika; 24: No. 5, 56-64(1977).

Toxic oxides of nitrogen which formed during the burning of oil in boiler furnaces are a source of considerable air pollution. This pollution can be reduced by developing new and more effective methods of burning fuels in which the formation of NO/sub x/ is suppressed. Experimental work in the USSR on NO/sub x/ formation in oil burners and the development of a method for calculating the quantity of NO/sub x/ in oil furnace combustion products are described. Experimental and theoretical results are compared. The results of determining NO_2 experimentally at 100 different operational conditions of boilers were compared with the results obtained by the theoretical method. A relative deviation of less than +-5 percent was obtained in 77 cases, deviations within limits of +-(5 to 10) percent in 13 cases and of more than +-10 percent in 10 cases. There were no relative deviations of more than +-12 percent. (LCL)

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 42614

42649 (EPRI-EL—727) **Frequency domain analysis of low-frequency oscillations in large electric power systems. Interim report. Applications of a small-scale computer program.** Byerly, R.T.; Sherman, D.E.; Bennon, R.J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Systems Technology Div.). Apr 1978. 71p. Dep. NTIS, PC A04/MF A01.

Mathematical models and computing methods for determining the natural freqencies and damping of generator rotor oscillations in large electric power systems are described. These models and methods provide the basis for estimating those eigenvalues most intimately related to rotor motion. The principal computational problem is the calculation of incremental voltage oscillations in a linear system model subjected to an external forcing function. This linear system model is derived from networks and generator representations employed in conventional time domain stability calcula-

tions. Methods of calculating voltages using this model are discussed. The use of these voltages in an iterative process to estimate eigenvalues is explained.

42650 (KFK-PDV—106) **New concepts of control centre design and development. Supervision of an electric power distribution system.** Dittmar, E.; Kiersch, J.J.; Schmudlach, U.; Weihrauch, J. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Prozesslenkung mit DV-Anlagen). Feb 1977. 123p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

The concept of modern control center technology is shown, including the supervision of an electric power distribution system is described. A modern control center is characterized by the fact that the conventional control elements are more and more replaced by elements of computer technology, i.e. computer and displays. The different functions implemented by hard- and software set new standards relative to flexibility, adaptability, and dimensioning. The communication interface man/process is defined and designed in a new way allowing dynamic and more efficent supervision strategy of technical processes via display in different operation modes. Special attention is paid to adjustments and extensions of process elements and their integration into the supervised network.

42651 (LBL—6367) **Electrical load management for the California water system.** Krieg, B.; Lasater, I.; Blumstein, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1977. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

To meet its water needs California has developed an extensive system for transporting water from areas with high water runoff to areas with high water demand. This system annually consumes more than 6 billion kilowatt hours (kWh) of electricity for pumping water and produces more than 12 billion kWh/year of hydroelectric power. From the point of view of energy conservation, the optimum operation of the California water supply system would require that pumping be done at night and generation be done during the day. Night pumping would reduce electric power peak load demand and permit the pumps to be supplied with electricity from "base load" generating plants. Daytime hydro power generation would augment peak load power generation by fossil-fuel power plants and save fuel. The technical and institutional aspects of this type of electric power load management for water projects are examined for the purpose of explaining some of the actions which might be pursued and to develop recommendations for the California Energy Resources Conservation and Development Commission (ERCDC). The California water supply system is described. A brief description is given of various energy conservation methods, other than load management, that can be used in the management of water resources. An analysis of load management is presented. Three actions for the ERCDC are recommended: the Commission should monitor upcoming power contract negotiations between the utilities and the water projects; it should determine the applicability of the power-pooling provisions of the proposed National Energy Act to water systems; and it should encourage and support detailed studies of load management methods for specific water projects.

42652 (N—78-11511) **Algorithm for constrained optimization with semismooth functions.** Mifflin, R. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Feb 1977. Contract AFOSR-74-2695. 36p. (IIASA-RR—77-3). NTIS PC A03/MF A01.

Large-scale optimization models appear in many areas of application at IIASA. For example, such models are useful for estimating the economic value of introducing solar and wind generated electrical energy into an existing power grid and for determining equilibrium prices for agricultural commodities in international trade as a function of national policies. Certain methods of decomposition for solving such optimization problems require the solution of a relatively small problem, the objective function of which is not everywhere differentiable. An implementable algorithm that can be used to solve such nonsmooth optimization problems is presented.

42653 **Load modelling for power flow solutions.** Murty, P.S.R. (Osmania Univ., Hyderabad, India). *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 162-165(Dec 1977).

Correct modelling of composite system loads for load flow studies is an essential pre-requisite for all subsequent uses of the results. As all load buses are not fully voltage controlled an exponential relationship for the voltage dependence of composite loads is recommended. For large systems with several radial lines extending to various directions, the reduction of the network into an equivalent smaller system with all major buses retained requires accurate representation of the transferred loads at the various load buses. Exponential representation is more convenient for representing such transferred loads. The Newton-Raphson method can be applied for the load flow solution with slight modification of the elements of the Jacobian. The method is illustrated for a sample system.

42654 **Suboptimal regulator for automatic generation control of power system.** Saha, N. (Regional Engineering Coll., Durgapur, India); Tripathy, S.C. *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 176-184(Dec 1977).

A suboptimal control law is formulated for load-frequency control of interconnected power systems. The control law is of proportional plus integral form. The suboptimal control law is obtained by model reduction technique. The effect of voltage regulator action on Pf transients is also studied.

AC SYSTEMS, EHV AND UHV

42655 (PB—273265) **Background information on high-voltage fields. Final report, 1970—1976.** Janes, D.E. Jr. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 24p. NTIS PC A02/MF A01.

To conserve fuel and to provide service as economically as possible, the electric utilities have been increasing the operating voltages of overhead transmission lines. Transmission at 345kV began in the mid-1950s. By 1980, it is estimated that 15% of the transmission capability will be on 765 kV lines and a prototype 1,100 kV line was to be completed in 1976. Although the bulk of the research evidence suggests that there are no prompt or acute adverse effects on biological systems and the environment from electric and magnetic fields associated with such transmissions, few studies have been designed to detect the effects of long-term exposures. Research needs on this subject include studies using existing electric field environments, studies in controlled simulated environments, studies on medical devices, and dosimetry studies. Included as appendices to the paper are several recently published references on biological effects of transmission lines.

42656 **Catalogue of electrical parameters of 110 to 400 kV overhead power lines.** Pyplacz, J.K. *Energetyka;* **31**: No. 4, 175-176(Apr 1977). (In Polish).

New principles are presented of electrical parameters for overhead lines, particularly a specification of quantities calculated for typical line sections. Also a method for using catalog data in power line parameters determination is described.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 43099, 43100, 43134

42657 **Nuclear AGRo breaks out again.** Patterson, W. (Friends of the Earth Ltd., London (UK)). *New Sci.;* **77**: No. 1088, 285-287(2 Feb 1978).

The discussions which have taken place in the UK since 1964 over the choice of reactor type for future power production are summarised. It is stated that the assumptions on which these discussions have taken place are all questionable. Since the Department of Energy has lowered its forecasts of future energy use dramatically since 1974 the question now arises as to whether nuclear power stations are to be ordered to provide necessary additional generating capacity or to provide work for power station builders. The recent decision to order two new AGR type power stations and to make a detailed design study of the PWR is questioned. It is wondered whether there is any necessity to choose the eventual reactor for the forward nuclear power programme at this time.

42658 **Nuclear power for the Greek grid.** Angelopoulo, M. (Public Power Corp., Athens (Greece)). *Nucl. Act.;* No. 18, 26-29(Jan 1978).

Nuclear power will come to take up an increasingly important role in the generation of electricity in Greece. Present electric power generating units, mainly thermal and hydroelectric power plants, will continue to be installed and will operate alongside nuclear power plants and other sources of energy.

42659 **Reactor technology. Atomic structure.** Erdoes, P. *Tech. Rundsch.;* **69**: No. 48, 9, 11, 13(29 Nov 1977). (In German).

This is one of a series of articles discussing aspects of nuclear engineering ranging from a survey of various reactor types for static and mobile use to mention of atomic thermo-electric batteries of atomic thermo-electric batteries for cardiac pacemakers. Various statistics are presented on power generation in Europe and U.S.A. and economics are discussed in some detail. Molten salt reactors and research machines are also described.

42660 **Reactor Technology. Atomic Structure.** Erdoes, P. *Tech. Rundsch.;* **69**: No. 45, 25, 27(8 Nov 1977). (In German).

This article, reviewing nuclear reactor techniques, deals with reactor shielding and the different types of reactor and their applications. The following types of reactor are briefly reviewed: gas-cooled reactors using CO_2 or helium, boiling water reactors, pressur-

ized water reactors, liquid-metal-cooled reactors, and high-temperature reactors. Ship propulsion is also discussed.

42661 Energy-economy aspects of nuclear power stations heat utilization. Winkens, H.P. (Stadtwerke Mannheim Aktiengesellschaft, Mannheim, Germany, F.R.). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 818-824(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

The economy of the utilization of heat available from nuclear power stations in Germany for the purpose of district heating is discussed, considering both heat generation and its transport over considerable distances required as well as the minimum energy density at the heat receiving end needed for economical operation of the schemes.

42662 Experience of transfer of nuclear technology. Sethna, H.N. (Department of Atomic Energy, Bombay (India)). *URJA;* **2**: No. 1, 20-24(Jul 1977).

The experience gained by India in building up a self-reliant broad-based nuclear industry is reported. The transfer of technoloqy from research and development groups to manufacturing operations, project sites, and construction of power plants is described. Obstacles encountered during design and operations and methods improvement of the electronic industry and training of personnel are mentioned.

42663 Whose power to choose. International institutions and the control of nuclear energy. Johnson, B. London; International Institute for Environment and Development (1977). 79p.

The subject is dealt with in sections entitled: the politics of bypassing plutonium; the spread of 'peaceful' nuclear technology - trends and prospects; nuclear power proliferation - international arrangements for promotion and control; international institutional reform - some aims and functions.

42664 Energy resources. McMullan, J.T.; Morgan, R.; Murray, R.B. (New Univ. of Ulster, Coleraine (UK). School of Physical Sciences). London; Edward Arnold (1977). 177p.

The book deals with the energy resources available, and then with techniques of energy conversion. Chapters follow on natural, fossil and nuclear sources and their associated technologies. The chapter on nuclear power covers both fission and fusion reactions, types of reactor, reactor safety and radioactive waste. The book ends with a chapter in inefficiencies (waste heat, waste products, the heat pump, insulation, etc.).

42665 Jahresbericht 1976/77. (Annual report 1976/77). Juelich, Germany, F.R.; KFA (1977). 143p. (In German).

The annual report 76/77 includes nine summarizing essays from the research program of the NRP (nuclear research plant), six reports on research and development in the fields of high temperature reactor, energy techniques, nuclear fusion, material characteristics, materials research, nuclear basic research, life - environment - safety, methods and infrastructure. Then the research institutes and the technical joint systems are briefly introduced, and organisation, administration, and the technical infrastructure are described.

42666 Problem Kernenergie. Eine kritische Information. (Problem of nuclear power. A critical information). Schmidt, G. Braunschweig, Germany, F.R.; Vieweg (1977). 174p. (In German).

The book deals with the highly popular question of whether nuclear power plants are needed at all. The author tries to find the answer with regard to the present and the expected future situation. Economical and technical points of view are taken into consideration. The author avoids neither the problem of waste management of nuclear power plants nor the one of citizen's initiatives. This specialized book in generally understandable form is apt for use for study, for lectures and for gaining an opinion on the pros and contras of peaceful utilization of nuclear energy.

42667 Challenges to come. Cahill, L. (Hydro-Quebec, Montreal (Canada)). pp 10 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session V, Paper 2. Montreal, Canada; Ecole Polytechnique ([nd]). (In French)

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

A scenario is presented for meeting Quebec's demand for electric power to the year 2000. The nuclear option requires planning to secure acceptable sites and dependable supplies of heavy water and uranium.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 42852, 42898, 42927, 42930, 42937, 42940, 42942, 42944, 42951, 42952, 42979, 42980, 42990, 42998, 43021, 43022, 43023, 43024, 43026, 43027, 43028, 43031, 43032, 43033, 43036, 43715

42668 (AE—517) Release of corrosion products from cobalt containing structural materials. Pt. 1: 18Cr8Ni-steel. Falk, I. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Oct 1977. 33p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The release rate for corrosion products from 18Cr8Ni-steel in feedwater and BWR environments is determined. The study has been performed using a high pressure loop in which irradiated specimens of the material have been exposed for up to 940 hours. Released corrosion products were identified using gamma-spectroscopy. Specimens with marked differences in the cobalt content were exposed partly to low and partly to high flow rates.(author).

42669 (EPRI-NP—672(Vol.1)) Spatial distribution of fission product gamma-ray energy deposition in light water reactor fuel elements. Final report. Bass, R.B.; Johnson, W.R. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Apr 1978. 87p. Dep. NTIS, PC A05/MF A01.

Experimental studies were undertaken to produce a precise and readily interpretable description of the distribution of absorbed energy in a LWR fuel element. A mock-up was constructed consisting of a 10 x 10 matrix of cladding tubes two feet long and loaded with depleted UO_2 to form fuel pins. Internal dimensions were such that the mock-up simulated precisely a section of a PWR fuel element. Some measurements were also made in a configuration which simulated a typical BWR fuel element. Monoisotopic sources were inserted between the fuel pellets in the center of the assembly. Measurements were made with sources of ^{60}Co, ^{137}Cs, and ^{51}Cr, whose gamma radiations were typical of major fission product sources. Lithium fluoride thermoluminescent dosimeters (TLDs) were selected as the detectors. A large number of data points have been measured, with an average standard deviation of 6 percent. These data are useful in determining the spatial distribution of the absorption of fission product gamma ray energy around regions of high local power density following the shutdown of a nuclear reactor.

42670 (EPRI-NP—672(Vol.2)) Spatial distribution of fission product gamma-ray energy deposition in light water reactor fuel elements. Final report. Bass, R.B.; Johnson, W.R. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Apr 1978. 136p. Dep. NTIS, PC A07/MF A01.

Experimental studies were undertaken to produce a precise and readily interpretable description of the distribution of absorbed energy in a LWR fuel element. A mock-up was constructed consisting of a 10 x 10 matrix of cladding tubes two feet long and loaded with depleted UO_2 to form fuel pins. Internal dimensions were such that the mock-up simulated precisely a section of a PWR fuel element. Some measurements were also made in a configuration which simulated a typical BWR fuel element. Monoisotopic sources were inserted between the fuel pellets in the center of the assembly. Measurements were made with sources of ^{60}Co, ^{137}Cs, and ^{51}Cr, whose gamma radiations were typical of major fission product sources. Lithium fluoride thermoluminescent dosimeters (TLDs) were selected as the detectors. A large number of data points have been measured, with an average standard deviation of 6 percent. These data are useful in determining the spatial distribution of the absorption of fission product gamma ray energy around regions of high local power density following the shutdown of a nuclear reactor.

42671 (EPRI-NP—733) Feasibility of using adaptive learning networks for eddy current signal analysis. Final report. Shankar, R.; Brown, C.L.; Mucciardi, A.N.; Davis, T.J. (Adaptronics, Inc., McLean, Va. (USA)). Mar 1978. 64p. Dep. NTIS, MF A01.

Portions of document are illegible.

Unambiguous discrimination and accurate sizing between simulated pits and cracks have been obtained via Adaptive Learning Network (ALN) flaw-classification and ALN flaw-size models for both single and multiple frequency eddy current data. In terms of sizing flaws, the error rates were 2.4 percent for pits and 3.6 percent for cracks. Eddy current signal responses were generated, recorded, and digitized from several simulated pits and cracks in sample nuclear reactor steam generator tubing. These responses were parameterized to measure the in-phase and quadrature signal and power components. It is concluded from this feasibility study, which considered 100, 200, 300 and 400 kHz signals, that the optimum inspection mode for pits is with a single frequency (400 kHz) eddy current

carrier signal and the optimum inspection mode for cracks is with multiple frequencies (200 kHz and 400 kHz).

42672 (EPRI-NP—755) **Major outage trends in light water reactors. Interim report.** Burns, E.T. (Science Applications, Inc., Palo Alto, Calif. (USA)). Apr 1978. 149p. Dep. NTIS, PC A07/MF A01.

The report is a summary of the major outages which occurred in light water reactor plants during the period January 1971 through June 1977. Only those outages greater than 100 hours duration (exclusive of refueling outages) are included in the report. The trends in outages related to various reactor systems and components are presented as a function of plant age, and alternatively, calendar year. The principal contributors to major outages are ranked by their effect on the overall outage time for PWRs and BWRs. In addition, the outage history of each operating nuclear plant greater than 150 MWe is presented, along with a brief summary of those outages greater than two months duration.

42673 (NEDO—23786) **Fuel rod prepressurization.** Elkins, R.B. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Engineering Div.). Mar 1978. 23p. General Electric Co., San Jose, CA.

This report describes the technical benefits and safety significance associated with prepressurizing General Electric Boiling Water Reactor (GE BWR) fuel rods with helium to 3 atmospheres. This potential design change results in minor changes to calculated plant safety parameters and is a simple product improvement which should enhance fuel reliability.

42674 (NUREG—0245) **Commerical electric power cost studies. Capital cost addendum multi-unit coal and nuclear stations.** (United Engineers and Constructors, Inc., Philadelphia, Pa. (USA)). Sep 1977. Contract EY-76-C-02-2477. 225p. (COO—2477-9). Dep. NTIS, PC A10/MF A01.

This report is the culmination of a study performed to develop designs and associated capital cost estimates for multi-unit nuclear and coal commercial electric power stations, and to determine the distribution of these costs among the individual units. This report addresses six different types of 2400 MWe (nominal) multi-unit stations as follows: Two Unit PWR Station-1139 MWe Each, Two Unit BWR Station-1190 MWe Each, Two Unit High Sulfur Coal-Fired Station-1232 MWe Each, Two Unit Low Sulfur Coal-Fired Station-1243 MWe Each, Three Unit High Sulfur Coal-Fired Station-794 MWe Each, Three Unit Low Sulfur Coal-Fired Station-801 MWe Each. Recent capital cost studies performed for ERDA/NRC of single unit nuclear and coal stations are used as the basis for developing the designs and costs of the multi-unit stations. This report includes the major study groundrules, a summary of single and multi-unit stations total base cost estimates, details of cost estimates at the three digit account level and plot plan drawings for each multi-unit station identified.

42675 (PB—274142) **Evaluation of fission product afterheat. Quarterly report, 1 April—30 June 1977.** Spinrad, B.I. (Oregon State Univ., Corvallis (USA). Dept. of Nuclear Engineering). Dec 1977. Contract AT(49-24)-0157. 39p. (NUREG—0018-7). NTIS PC A03/MF A01.

This report covers work under the subject contract during the spring quarter of 1977. The goal of the contract is to improve the understanding of shutdown power in reactors due to radioactive decay of fission products, particularly for light water reactors in the period 0-1000 seconds after shutdown. The power produced during this period is a primary determinant of core shutdown-cooling requirements. Much of the work done during this quarter was in preparation of the final report for this project. A review paper, 'Evaluation of Fission Product After-Heat,' prepared for the American Nuclear Society Topical Meeting on Thermal Reactor Safety (Sun Valley, Idaho, July 31 - August 4, 1977) therefore is an appropriate summary of progress through the quarter, and forms the main body of this progress report. It is followed by brief notes on other work.

42676 Soil-structure interaction for transient loads due to safety relief valve discharges. Tseng, W.S.; Tsai, N.C. (Bechtel Power Corp., San Francisco, Calif. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 251-259(Jan 1978).

Dynamic responses of BWR Mark II containment structures subjected to axisymmetric transient pressure loadings due to simultaneous safety relief valve discharges were investigated using finite element analysis, including the soil-structure interaction effect. To properly consider the soil-structure interaction effect, a simplified lumped parameter foundation model and axisymmetric finite element foundation model with viscous boundary impedance are used. Analytical results are presented to demonstrate the effectiveness of the simplified foundation model and to exhibit the dynamic response behavior of the structure as the transient loading frequency and the foundation rigidity vary. The impact of the dynamic structural response due to this type of loading on the equipment design is also discussed.

42677 Decommissioning of light-water reactor nuclear power plants. Bardtenschlager, R.; Bottger, D.; Gasch, A.; Majohr, N. (Nuklear-Ingenieur Service G.m.b.H., Frankfurt am Main (Germany, F.R.)). *Nucl. Eng. Des.;* **45**: No. 1, 1-51(Jan 1978).

This study deals with the technical and economic questions posed by the decommissioning of light-water reactor nuclear power plants of the 900-1300 MW class, account being taken of the distinctions between boiling- and pressurized-water reactors. Possible decommissioning alternatives and the disposal or confinement of activity are discussed. It emerges from the discussion that decommissioning, and even total dismantlement of these nuclear power plants is in principle feasible. The activity inventory, one year after shutdown, is calculated to be about 3×10^7 Ci for the BWR and 4×10^6 Ci for the PWR; 40 years after shutdown these figures are reduced to 2×10^6 and 4×10^5 Ci, respectively. The decommissioning costs to be expected are also estimated. This estimate serves as the basis for an economic comparison by the present worth method. The economic comparison shows that total dismantlement after a cooling time of one year is more than four times as expensive as interim confinement followed by total dismantlement waiting period of 40 years. The present worths for immediate total dismantlement are estimated at DM 200 million for the BWR and DM 170 million for the PWR; for the other alternative, they are put at DM 45 million for the BWR and DM 42 million for the PWR. A still open question is posed by the final storage of the large quantities of bulky radioactive waste arising in partial or total dismantlement. Since no decision on the storage method has yet been taken, disposal in casks is stipulated as a boundary condition in the estimation of the costs, although this is an unrealistic assumption. It is to be presumed that the costs of disposal can be reduced given appropriate final storage.

42678 Kerntechnische Anlagen. Wiederkehrende Pruefungen. T. 2. Magnetpulverpruefung. Entwurf. (Nuclear facilities. Recurrent inspections. Pt. 2. Magnetic powder inspection. Draft). Berlin, Germany, F.R.; Beuth (Oct 1977). 7p.

This standard applies to magnetic powder inspections on the pressure containment for the coolant of LWR reactors. A method for the detection of material separations and inhomogeneities in the surfaces of the pressure containment of the reactor coolant is established.

42679 Operating experience of Hamaoka Nuclear Power Station. Yukawa, Y.; Sakairi, T. (Chubu Electric Power Co. Inc., Nagoya (Japan)). *Nippon Genshiryoku Gakkaishi;* **19**: No. 6, 399-403(Jun 1977). (In Japanese).

Hamaoka Nuclear Power Station Unit 1 was built as the first nuclear power station of Chubu Electric Power Co. The plant is 540 MW standard BWR-4 with some specific considerations in seismic design and intake structure. Commercial operation began on Mar. 17, 1976, 1st cycle ended on Oct. 1, 1976, at core average burnup of 8,563 MWD/t. Forty four fuel assemblies were refuelled during first regular overhaul and maintenance period. Much effort has been made to keep good integrity of fuel rod, both on the process of fuel design and manufacturing and on the operation of the reactor, resulting in no failed fuel was detected upto now. Core and fuel management system has been developed including basic physics calculation, operating guide calculation, operational and fuel accounting data storage and many others. Terminal console (including I/O machine) at plant site has been utilized effectively to accomplish real-time calculation for better plant operation.

42680 Control of radioactive waste disposal system for BWR plants. Hayakawa, H.; Nakajima, T.; Takahara, T.; Wada, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). *Toshiba Rebyu;* **32**: No. 6, 492-496(Jun 1977). (In Japanese).

Control of radioactive waste disposal systems for BWR nuclear power plants has been developed in many aspects. Automatic sequence control, graphic panels and CRT displays are required for improving the operability of the system. This article outlines the automatic control, graphic panel design and simulation test using the sequence controller for radioactive waste disposal systems for BWR plants.

42681 Consideration for safety design of pipings in preparing the program of instrumentation. Hashimoto, M. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). *Haikan Gijutsu;* **19**: No. 7, 147-155(Jun 1977). (In Japanese).

The safety design to be considered in the preparation of the program of instrumentation is described, taking a recent BWR nuclear power station as an example. The fundamental items of safety design include the assumption of single failure, the adoption of redundancy, the securing of physical independency and separation, the adoption of fail-safe and fool-proof design, the employment of highly reliable logic circuits, the automation of operation, and the provision of possibility of in-service testing. In system constitution,

the securing of redundancy and the automation of operation must be considered against the design basis accident, while in steady operation, the indirect cooling system for station auxiliaries and the independence must be considered. In the system design specifically of emergency core cooling system, the possibility of in-service testing, the duplication of water source, the installation of minimum flow line and the prevention of reverse flow of reactor water should be considered. The provision of isolation valves, the restriction of outflow of primary fluid, the prevention of leakage between systems, the duplication of valves and the parallel arrangement of equipments should be considered around the reactor and auxiliary systems. Design conditions must be determined by assuming maximum operating conditions. The physical separation of equipments is the indispensable measure in system installation to avoid the common mode failure due to missile phenomenon, flooding or the like. This applies also to electrical systems and instrumentation and control systems.

42682 Model engineering for piping layout of boiling water reactor nuclear station. Tsukada, K.; Uchiyama, M. (Japan Atomic Power Co., Tokyo); Wada, T.; Jibu, N. *Hitachi Hyoron;* **26**: No. 6, 189-194(Jun 1977).

A nuclear power station is made up of a wide variety of equipment, piping, ventilation ducts, conduits, and cable trays, etc. Even if equipment arrangement and piping layout are carefully planned on drawings, troubles such as interference often occur at field installation. Accordingly, it is thought very useful to make thorough examinations with plastic three-dimensional models in addition to drawings in reducing troubles at field, shortening the construction period, and improving economics. Examination with plastic models offers the following features: (1) It permits visual three-dimensional examination. (2) Group thinking and examination is possible. (3) Troubles due to failure to understand complicated drawings can be reduced drastically. Manufacturing a 1/20 scale model of the reactor building of the Tokai No. 2 Power Station of the Japan Atomic Power Co., Hitachi has performed model engineering-solution of interference troubles related to equipment and piping, securing of work space for in-service inspection (ISI), carry-in/installation of various equipment and piping, and determination of the piping route of which only the starting and terminating points were given under the complicated ambient conditions. Success with this procedure has confirmed that model engineering is an effective technique for future plant engineering.

42683 Development and installation of 500kV oil-filled cable. Suetsugu, T.; Oka, K.; Ooe, T.; Sakurai, S.; Ozaki, Y. (Furukawa Electric Co. Ltd., Tokyo (Japan)). *Furukawa Denko Jiho;* No. 61, 15-22(May 1977). (In Japanese).

We received an order for an extra high voltage (500kV) OF cable for use for the No. 5 reactor of Tokyo Electric Power Co.'s No. 1 Nuclear Power Station and completed its installation and jointing in July, 1975. This is the first 500kV OF cable ever supplied by us for an actual power line and is the result of the basic researches, production of prototype cables and their tests which we had carried out for many years. The OF cable for the above power plant was given a normal working potential gradient of not more than 15kV/mm and an insulation thickness of 33mm. Because of its high flexural rigidity (EI), twice that of 275kV cable, this OF cable was laid not in a snaking pattern but with an aid of a specially designed suspending hardware at the curved sections of both rising ends in order to cope with thermal expansion and contraction.

42684 Central measurement-value acquisition facility (ZMA) for slow and fast measurements at the HDR. Schneider, R.O. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Heissdampfreaktor-Sicherheitsprogramm); Diziol (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). *KFK Nachr.;* **9**: No. 2, 35-37(1977). (In German).

The experimental instrumentation is to pick up phenomena of the structure and the fluid during and after the intended experiments in such a way that qualitative as well as quantitative results may be obtained as to the stresses and their consequences. The operational instrumentation has got the task to monitor the plant by measuring technique so that the state of operation of the plant will correspond to the required boundary conditions of the experiments (e.g. enthalpy stratification in the pressure vessel). Between the experiments the acquired data are to be processed for documentation and evaluation with the aid of the on-line computer system integrated in ZMA.

42685 Material and strength investigations on the pressure vessel and pipeline system of the HDR (EV 2000). Issler (Max-Planck-Institut fuer Metallforschung, Stuttgart (Germany, F.R.)); Katzenmeier (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Heissdampfreaktor-Sicherheitsprogramm). *KFK Nachr.;* **9**: No. 2, 19-25(1977). (In German).

Within the framework of the HDR safety programme, the following strength tests were carried out on the reactor pressure vessel and on the pipeline system: 1) measurement of the impact work as a function of the temperature of the pressure vessel material 23NiMoCr36 on three samples (bore samples) from the vessel wall (basic and welding material); 2) fatigue strength tests on samples of the piping material X10CrNiNb189; 3) experimental stress analysis on the pressure vessel at 'cold' pressure test and with earthquake tests.

42686 Use of non-destructive test methods at the HDR reactor. Schmuelling (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Heissdampfreaktor-Sicherheitsprogramm); Deuster. *KFK Nachr.;* **9**: No. 2, 11-18(1977). (In German).

Non-destructive testing is a way to determine the material state of the reactor pressure vessel and of the pipelines belonging to it. Existing flaws as well as new flaws resulting from various load tests must be detected and determined, along with their possible growth. This way, it is made sure that, on the one hand, there will be no uncontrolled failure of HDR components at the loads envisaged and, on the other hand, that a failure and system analysis can be carried out.

42687 Coolant dispersing device. Sugisaki, T.; Horiuchi, T.; Yamanari, S.; Tominaga, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-7209π/A/. 10 Dec 1975. 6p. (In Japanese).

A method to eliminate vibrations of a neutron detector tube to prevent possible failure of a channel box is described. In a coolant dispersing device wherein a cover member (fixed frame) is detachably mounted upwardly of a coolant inlet formed in a core support which supports a lower portion of a fuel assembly within a reactor container, a flow dispersing plate covers an upper portion of a leak hole to laterally disperse and spread a leaked flow, which moves up from the lower plenum passing through the leak hole in a core supporting plate at the normal operation of reactor and to eliminate a local flow of core bypass flow at the lower portion of a neutron detector tube. Thus, vibration of the neutron detector tube may be prevented.

42688 Fuel exchanging apparatus. Imada, T.; Sato, H. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-70297/A/. 8 Dec 1975. 6p. (In Japanese).

A centripetal device is described which has an initial spring force greater than a frictional force in an oscillating direction of a telescope mast, on a mast fixing device mounted on a body of fuel exchanging apparatus so that the telescope mast may be secured quickly returning to a predetermined initial position. When the body of fuel exchanging apparatus is stopped at a predetermined position, a tension spring, which has an initial spring force greater than a frictional force in an oscillating direction of the telescope mast, causes a lug to be forced by means of a push rod to position a sliding base plate to its original position. At the same time, a device of similar structure causes an operating arm to be positioned to the original position, and a lock pin urged by a cylinder is inserted into a through hole in the sliding base plate and operating arm so that the telescope mast may be fixed and retained.

42689 Failed fuel element detector. Kikuchi, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-67493/A/. 3 Dec 1975. 4p. (In Japanese).

A method to permit highly accurate detection of failed fuel elements by causing gaseous nuclear fission products within fuel cans to issue to the outside and be captured is described. A water sampling head is mounted on a fuel assembly to stop the flow of water coolant within the fuel channel. Thereafter, the plenum atop the fuel rod is heated with water coolant from a heater to allow the gaseous nuclear fission products within the fuel rod to issue to the outside from a failed portion. The out-coming gaseous nuclear fission products are guided together with water coolant to a gas-liquid separator, and the radioactivity of the separated nuclear fission products is measured to thereby detect failure of the fuel element.

42690 Fuel assembly. Saito, S.; Suzumura, T.; Kamo, Y. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-67482/A/. 3 Dec 1975. 3p. (In Japanese).

A method to reduce the quantity of deformation due to enlargement of a channel box and to prevent leakage of the coolant is described. A plate spring for preventing the leakage of a coolant and to be inserted in the space defined between a lower tie plate for supporting the fuel rod and channel box covering the periphery of the tie plate, is folded in a number of stages in the vertical direction and is provided with alternate protuberances to be in forced contact with said tie plate and channel box.

42691 Measuring instruments of void quantity in nuclear reactors. Fukunishi, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-66193/A/. 1 Dec 1975. 3p. (In Japanese).

Object: To determine the behavior of voids produced in a reactor core by measuring the quantity of voids produced during operation in the axial direction of the core. Structure: A neutron flux measurement signal from a neutron flux detector on the same string disposed in the reactor in the axial direction thereof and a physical

quantity measurement signal representing physical quantities which effect the dynamic characteristics of the entire core are rendered into a time series signal. This signal is subjected to statistical treatment for deriving such a signal as will represent dispersion of white noise and so forth, and on the basis of this signal the void quantity is calculated. The resultant void power spectrum density signal is displayed on a C.R.T. or the like.

42692 Measuring instruments of power distribution within reactors. Izumi, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-66195/A/. 1 Dec 1975. 3p. (In Japanese).

A method to obtain average power distribution within a BWR type reactor by compensating the power distribution within the reactor in the axial direction, measured by a detector for detecting power within the reactor, with a value obtained by adding the weight of power distribution within the reactor to the output measured by an average power detector is described. A local power detector is disposed within a measuring instrument tube of a BWR type reactor in the axial direction of the tube for obtaining average output from the local power detector. By utilizing the fact that the noise component in the average output obtained in this way is linearly related to the change in power distribution within the BWR type reactor detected by the movable in-core detector and also that the maximum amplitude of the noise component is linearly related to the average output, the value obtained by adding the weight of the afore-mentioned power distribution within the reactor to the average output is subtracted from the power distribution within the BWR type reactor, as measured by the detector within the reactor, thereby obtaining average power distribution within the reactor.

42693 Fuel support. Mori, S.; Ejiri, F. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-64590/A/. 26 Nov 1975. 5p. (In Japanese).

A method to form orifices, through which a bypass flow passes, in a fuel support, to thereby prevent an outer wall of a fuel assembly from being damaged as a result of vibration of a neutron detector tube due to coolant jet is described. In a fuel support mounted on a core supporting plate in a boiling water reactor, a suitable number of orifices are provided to provide communication between a lower plenum under the core supporting plate and a water gap between fuel channel boxes to flow a part of coolant into the water gap through said orifices.

42694 Core construction of a reactor. Kawahara, A.; Ajima, F. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-59292/A/. 10 Nov 1975. 6p. (In Japanese).

A method to prevent vibrations of a core inserting tube for in-pile instrumentation, generated by a flow of cooling water is described. A plurality of fuel assemblies arranged in the core portion are supported by upper and lower core supporting members. A coolant feed pipe formed with a coolant passage is inserted between the fuel assemblies extending through the lower core supporting member, and an opening of the coolant passage which opens at a level upwardly of the lower core supporting member is provided in the coolant feed pipe.

42695 Fuel assembly. Akimoto, S. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57489/A/. 7 Nov 1975. 5p. (In Japanese).

A method to suppress vibrations of a core insertion tube, in which reactor interior measuring means are inserted, by providing leak holes in a fuel assembly used in a boiling water type reactor is described. Leak holes are formed in a channel wall enclosing the assembly of fuel rods of a fuel assembly used for a boiling water type reactor. These leak holes are provided to face a gap where no control rod is inserted. With this arrangement, the cooling water sprayed from the leak holes impinges upon the facing channel wall before it is scattered. Thus, sudden pressure variations can be prevented so that the vibrations of the core insertion tube can be suppressed.

42696 Coolant recirculation system. Aizu, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-54895/A/. 31 Oct 1975. 5p. (In Japanese).

A method to improve the safety of personnel during the non-destructive inspection of a BWR type reactor by simplfying the coolant recycling system outside the reactor container is described. A coolant distributing chamber is provided within the reactor container, and a coolant distributing duct having one end inserted in the top opening of a jet pump disposed in an annular space formed between the reactor container and core section and the other end communicated with the coolant distributing chamber is provided. The coolant distributing chamber and annular space are communicated with each other through a recycling system duct line. Thus, no distributing header is provided outside the pressure container unlike the prior art. This greatly reduces the welded portion in the coolant recycling system outside the pressure container thereby to reduce the portions requiring inspection by supersonic waves and so forth.

42697 Method of controlling the operation of a feedwater system. Takemaru, K.; Omori, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-52094/A/. 22 Oct 1975. 4p. (In Japanese).

A method is described to maintain a good operating characteristic without stopping a pump at the downstream at the time of pump trip at upstream. In the event that one of pumps at the upstream (for example, a condenser pump) is tripped, interlock is activated to forcibly open a circulating valve for a condensation booster pump to partly return the flow rate of discharge to a pump suction part, thus preventing a decrease in suction pressure. In this case, in order to control suction pressure to a suitable level of pressure more than a net suction water head as required, a pressure adjusting meter for the condensation booster pump is provided on a pipe line on the side of suction so that the flow rate of circulation may be changed by the pressure adjusting valve to maintain the suction pressure in constant.

42698 Fuel assembly. Ueda, M. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-50498/A/. 21 Oct 1975. 5p. (In Japanese).

A method to vary a ratio of moderator to fuel volume within a channel box in an axial direction of fuel assembly to restrain power peak, thereby enhancing the power of the entire core in a boiling water reactor or the like is described. Fuel rods of normal length are arranged in the periphery in the channel box and fuel rods shorter than the first-mentioned fuel rods are arranged toward the center therefrom to form a conical flow passage for the moderator upwardly enlarged in the central portion, thereby flattening the distribution of the effective void rate in an axial direction of fuel assembly.

42699 Apparatus for mounting a neutron measurement monitor in a reactor. Futatsugi, M.; Watanabe, S. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-46296/A/. 8 Oct 1975. 6p. (In Japanese).

A method to guide and retain an operating machine, which holds and moves a monitor, on an installing guide to mount with accuracy a neutron measurement monitor by operation from a service platform on the reactor is described. An operating machine with a monitor held is inserted into an installing guide located and held on the lattice in the reactor, and the monitor is guided by an inclined bottom plate and placed in engagement with a guide pipe. After the operating machine is brought into engagement with the installing guide to be located and held, the monitor is stood upright by a fluid pressure cylinder to be engaged with an engaging portion and secured.

42700 Device for preventing leakage of coolant in nuclear fuel assembly. Kobayashi, Y.; Sekiguchi, M.; Yoshida, H. (to Nuclear Fuel Industries Ltd., Tokyo (Japan)). Japanese Patent 1977-43093/A/. 3 Oct 1975. 5p. (In Japanese).

A method to prevent leakage of coolant from between lower tie plate and channel box without causing deformation of the channel box and also without the possibility of disturbing the installation and removal of the box by the provision of a thin plate provided with leakage holes for the lower tie plate is described. Static water pressure within the lower tie plate is adapted to act upon the bear side of a flat plate for leakage prevention through leakage holes formed in the tie plate, thus urging the flat plate against the channel box inner surface. Meanwhile, static water pressure having been led through the leakage holes in the flat plate is adapted to press the flat plate in the vertical direction, thus urging the flat plate against the channel box inner surface and thereby preventing leakage of the coolant through a gap between the channel box and lower tie plate.

42701 In-water searching device. Kaneko, T. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-41794/A/. 29 Sep 1975. 4p. (In Japanese).

A method to permit internal inspection of a reactor without erasing the image of a television monitor by hanging the television camera with a cable within the reactor and vertically moving it with a winch is described. A television camera is hung by a cable within the reactor and is adapted to be immersed into water in the inside of the reactor. The cable is adapted to be taken up on a take-up drum by the winch and is vertically moved by the operation of a winch. Since the television camera can always be furnished with power via the cable even during its vertical movement, exhaustive investigation can be made over the entire range of movement of the television camera.

42702 Device for inspecting abnormalities of a reactor. Ito, T.i; Shimiya, Y.; Aoki, R. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-36289/A/. 17 Sep 1975. 4p. (In Japanese).

A method to enable directly detection of mechanical behavior inside the pressure vessel of a reactor to detect an abnormal condition in its early stages is described. Vibrations of devices such as core or the like due to the flow of coolant are transmitted outside the pressure container through a vibration probe and then converted

into an electric signal by means of a vibration detector. The thus converted electric signal is regulated by a signal regulator, after which the effective value thereof is obtained by a signal analyser. When said value is greater than the value of a set comparator, an alarm and a reactor protector are actuated and the value is Fourier-converted and recorded into a recorder.

42703 **Fuel assembly for nuclear reactor.** Kiguchi, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-27989/A/. 27 Aug 1975. 3p. (In Japanese).

A method to improve the sensitivity of detection of fuel breakage in lower portion of the fuel assembly by so arranging as to permit sample water to be withdrawn and extracted from a water rod and thus obtain water in the lower portion of the fuel assembly in sipping is described. In a nuclear reactor fuel assembly, in which a hollow tube (i.e., water rod) having openings formed in upper and lower portions is disposed in lieu of a fuel rod or a plurality of fuel rods, the opening of the hollow tube upper portion reaches the upper portion of an upper fuel rod support plate. At the time of sipping, a heater is inserted through the opening for heating water in the fuel assembly or increase the sensitivity of detection of forced circulation. Also, water in the lower portion of the fuel assembly is sampled for detecting the failure of fuel in the lower portion of the assembly. Further, water in the fuel assembly lower portion is sampled for detection of the failure of fuel in the lower portion of the fuel assembly, while at the same time permitting gamma-scan to be effected from the inner side by inserting and running a gamma ray detector.

42704 **Piping for nuclear power reactors. Review.** Rodchenkov, B.S. *At. Tekh. Rubezhom;* No. 8, 3-10(Aug 1974). (In Russian).

The article reviews production technology, inspection methods, and general characteristics of pipes and tubing: 1 - for piping of the primary loop made of austenitic stainless steels type 304 and 316, and of piping running from the reactor to the steam generator or directly to the turbine in which case it is made of bimetallic materials for PWR and BWR reactors; 2 - for the cladding of fuel elements of PWR and BWR reactors which is made of zirconium alloys. Thus the technology of the Japanese forms "Kobe Steel" and "Sumimoto Metal Industry" is described as it is applied to the fabrication of fuel element cladding for the "Fukusima-2" and "Mihama-2" reactors. This has produced piping of higher corrosion resistance, of more favorable hydrides orientation and more stringent allowances in fabrication; 3 - for fuel element cladding of the magnox type for graphite reactors cooled with CO_2, for gas cooled reactors with elevated coolant temperatures (over 500°) made of chromenickel steel stabilized with titanium or niobium; 4 - for the fuel element cladding of fast reactors that are cooled with liquid sodium, where the cladding is made of type 316 stainless steel. The particularities of fabrication of channel tubing made principally of zircaloy-2 and zirconium-niobium alloy are given as well as the quality control required for the metal. Data are given on the types of materials used, on the dimensions and pressures used in the channel tubing made of zirconium alloys.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 42669, 42670, 42671, 42672, 42674, 42675, 42678, 42704, 42829, 42836, 42852, 42928, 42971, 42976, 42979, 42980, 42988, 42992, 42993, 42994, 42995, 43010, 43014, 43023

42705 (BNL-NUREG—23219) **Denting of Inconel steam generator tubes in pressurized water reactors. Third informal report.** van Rooyen, D.; Weeks, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1977. Contract EY-76-C-02-0016. 38p. Dep. NTIS, PC A03/MF A01.

The recent plant operating experience and laboratory test results on the phenomenon of denting in recirculating PWR steam generators is reviewed. Although denting was first reported only in plants that were converted from phosphate to AVT, it has now also been observed in plants still on phosphate, as well as in some that started on AVT. In some units, slightly abnormal eddy current signals have been observed at the top of the tube sheets. The degree of denting in operating steam generators may be related to the levels and duration of chloride inleakage. Chloride, however, is not the only active ingredient, and does not seem to give denting until local acid conditions arise; consequently, it may be necessary for soluble copper and/or nickel ions to be present to promote the denting reaction. Chloride concentrations in actively corroding crevices can increase by several orders of magnitude over the bulk coolant. It is thus difficult to develop a basis for Cl^- specifications for secondary water. Maintaining Cl^- low enough to prevent denting may be unmanageable without full flow condensate demineralization in coastal plants with copper alloy condensors and feedwater lines. Cathodic depolarization by oxidizing species are thought to promote the formation of acid chlorides in crevices and trigger the denting reactions; some ions may also catalyze the rapid formation of magnetite. These, and other mechanistic aspects of denting are discussed. The implications of the Inconel 600 tube defects at Ginna in non-dented areas, originating from the primary side, are also discussed.

42706 (EPRI-NP—514) **Study of magnetic filtration applications to the primary and secondary systems of PWR plants. Final report.** Troy, M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1978. 141p. Dep. NTIS, PC A07/MF A01.

A comprehensive state-of-the-art review of magnetic filtration has been made with the emphasis on the applications of the technology to nuclear power plant fluid systems. Conceptual designs for six potential applications are described and evaluated on the basis of their potential cost effectiveness. Three systems configurations (one for primary coolant filtration and two for secondary coolant filtration) were selected as having high potential. Application to the primary coolant is predicted to reduce the plant radioactivity from deposited crud by at least a factor of two. In the secondary side, a 75 to 85 percent reduction in sludge accumulation in the steam generators is possible, with the attendant reduction in the probability of steam generator corrosion problems. Specific test programs under realistic plant conditions for both primary and secondary applications are recommended.

42707 (EPRI-NP—723) **Feasibility of using adaptive learning networks for eddy current signal analysis. Final report.** Shankar, R.; Brown, C.L.; Mucciardi, A.N.; Davis, T.J. (Adaptronics, Inc., McLean, Va. (USA)). Mar 1978. 66p. Dep. NTIS, MF A01.

Portions of document are illegible.

Umambiguous discrimination and accurate sizing between simulated pits and cracks have been obtained via Adaptive Learning Network (ANL) flaw-classification and ALN flaw-size models for both single and multiple frequency eddy current data. In terms of sizing flaws, the error rates were 2.4 percent for pits and 3.6 percent for cracks. Eddy current signal responses were generated, recorded, and digitized from several simulated pits and cracks in sample nuclear reactor steam generator tubing. These responses were parameterized to measure the in-phase and quadrature signal and power components. The accuracy of ALN flaw classifiers and ALN flaw-size models, which were synthesized from these parameters, was independent of the presence of tube-support plates over the flaw region. It is concluded from this feasibility study, which considered 100, 200, 300 and 400 kHz signals, that the optimum inspection mode for pits is with a single frequency (400 kHz) eddy current carrier signal and the optimum inspection mode for cracks is with multiple frequencies (200 kHz and 400 kHz).

42708 (IWGFR—10, pp 159-161) **Utilization of focalised transducers to improve the control of mixed joint welds of ferritic and austenitic steels.** Papezyk, F.; Saglio, R.; Destribats, M.T. Jul 1976. (In French).

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Ultrasonic control of mixed joint welds in austenitic-ferritic steel is not easy with classical methods. This paper reports on the focalised transducers developed by the French CEA for the PWR type reactors.

42709 (WCAP—9233(Vol.1)) **High pressure water hammer test program for the split flow preheat steam generator.** Alba, J.; Basel, R.A.; Carlson, R.W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1978. 143p. Westinghouse Electric Corp., Pittsburgh, PA.

The purpose of the high pressure water hammer test program was to experimentally and analytically investigate the possibility of water hammer phenomena in the preheater region of preheat steam generators. In particular, those conditions that produced steam voids and their subsequent collapse by condensation and attendant depressurization were investigated. Volume 1 of the 3-volume report includes the test design and operation, test conditions and results, visual flow tests, scaling and test data application, and structural evaluation of steam generator tubes. (DG)

42710 (WCAP—9233(Vol.2)) **High pressure water hammer test program for the split flow preheat steam generator.** Carlson, R.W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1978. 126p. Westinghouse Electric Corp., Pittsburgh, PA.

The purpose of the high pressure water hammer test program was to experimentally and analytically investigate the possibility of water hammer phenomena in the preheater region of preheat steam generators. In particular, those conditions that produced steam voids

and their subsequent collapse by condensation and attendant depressurization were investigated. Volume 2 of the 3-volume report deals with the test facility description, the test apparatus design, data acquisition and error analysis, the test facility operating procedure, and instrumentation. (DG)

42711 (WCAP—9233(Vol.3)) **High pressure water hammer test program for the split flow preheat steam generator.** Carlson, R.W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1978. 174p. Westinghouse Electric Corp., Pittsburgh, PA.

The purpose of the high pressure water hammer test program was to experimentally and analytically investigate the possibility of water hammer phenomena in the preheater region of preheat steam generators. In particular, those conditions that produced steam voids and their subsequent collapse by condensation and attendant depressurization were investigated. Volume 2 of the 3-volume report deals with noncondensible gas effects on water hammer, gas analysis procedure and results, scaling analysis, and test conditions and results. (DG)

42712 (JPRS—70889) **Translations on Eastern Europe. Scientific Affairs No. 576.** 4 Apr 1978. Translation of various papers. 57p. NTIS.

The serial report contains articles concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences. Highlights include reactor physics research with WWER type reactors and the training of personnel for the Paks Nuclear Power Plant.

42713 Optimum modes of power control in a power plant reactor. Vasil'ev, S.A.; Gerasimov, A.S.; Pavlov, V.I.; Simonov, V.D. (Vsesoyuznyj Nauchno-Issledovatel'skij Teplotekhnicheskij Inst., Moscow (USSR)). *Kernenergie;* **21**: No. 3, 72-76(Mar 1978). (In Russian).

Three operating modes for optimum power control in a power plant reactor are considered taking xenon poisoning into account. The first mode realizes minimum shut-down time with warranted possibility of running up after a planned downtime of given duration. The second and third modes of operation warrant either maximum operating time at rated power or maximum energy liberation per cycle in the cyclic daily operation of the reactor including planned downtime during the night hours. Optimality of the operating modes thus determined is verified by using Pontryagin's maximum principle.

42714 Method for optimum composition of fuel loads in a WWER type reactor. Pobedin, V.V.; Simonov, V.D. (Vsesoyuznyj Nauchno-Issledovatel'skij Teplotekhnicheskij Inst., Moscow (USSR)). *Kernenergie;* **21**: No. 3, 77-81(Mar 1978). (In Russian).

The method of dynamic programming has been applied to the problem of optimum choice of core composition. An algorithm is given for minimizing the power peaking factor in the core. The proposed method is illustrated by methodological examples.

42715 Concerning calculation and construction of the natural-draft cooling tower of the Goesgen-Daeniken nuclear power station. Furrer, H.; Mischol, L. (Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland)). *Schweiz. Bauztg.;* **95**: No. 39, 689-696(29 Sep 1977). (In German).

The principal design criteria and constructional details of the 150 m high reinforced concrete, natural-draft cooling tower and its foundations are described, presenting an outline and the results of static and dynamic calculations and laboratory model tests. The article does not include the functional and operational aspects of the design.

42716 Development of PWR power-generating plants and the review. Ito, N. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). *Hatsuden Suiryoku;* No. 149, 61-76(Jul 1977). (In Japanese).

On the standpoint of the designer of PWR plants, the progress and the present state of the development of PWRs in Japan are outlined. PWR is the reactor type, the large commercial machines of which were first put in practical use, because it has been developed energetically as it is relatively easy to handle with conventional technologies in the principle and the design. The trend of advancing to large capacity is shown chronologically. In Japan, Mitsubishi group contracted the technical tie-up with Westinghouse and started the manufacture and sale of POR power-generating plants. In June, 1977, 6 units are in operation, 5 units are under construction, and 3 units are in safety deliberation stage. The design and manufacture technologies for PWRs in Japan were able to reach the world level in very short period. The main components of the steam-generating installation for PWR plants are the reactor vessel, coolant-circulating pumps, steam generators, the pressurizer, and coolant pipings. The efforts of improvement must be exerted to raise the rate of operation and reliability of plants, to make inspection, security and maintenance precise, to reduce the radiation exposure of workers, and to shorten the period of construction and repair. Especially, reactor containment vessels are explained. New construction sites, such as underground plants and offshore plants, are being investigated.

42717 Experience in training personnel for operation and maintenance during start-up, test running, and continuous operation of the Greifswald-1 and Greifswald-2 reactors of the "Bruno Leuschner" nuclear power plant. Sturm, A. (Ingenieurhochschule Zittau (German Democratic Republic)). *Energietechnik;* **27**: No. 6, 233-238(Jun 1977). (In German).

Analyzing maintenance of power stations and nuclear power stations in the GDR, general principles and parameters could be derived for extent, composition, and training of nuclear power plant personnel. A general strategy of training at the Ingenieurhochschule Zittau is presented.

42718 Model steam generator tests and secondary side water chemistry. Yashima, S. (Kansai Electric Power Co., Inc., Osaka (Japan)). *Karyoku Genshiryoku Hatsuden;* **28**: No. 5, 433-441(May 1977). (In Japanese).

The model test was carried out to investigate the cause of the decrease of wall thickness in the heat transfer tubes for the steam generator of Mihama nuclear power plant No. 1. It was found that the cause was the local corrosion resulting from the concentration of sodium phosphate in the places where the flow of secondary side water is hindered. The countermeasure was to replace sodium phosphate with volatilization treatment as the water quality control in the secondary system. The thermal flow test for confirming the state of dry and wet on tube surfaces, the crevice concentration test for confirming the occurrence of thickness reduction, the model steam generator test for reproducing the thickness reduction phenomenon, the presumption of the cause of the thickness reduction phenomenon, and the water quality control of secondary side water are explained in this paper.

42719 Requirements for operating flexibility of nuclear power plants and their meeting by light water reactors. Novak, S. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). *Jad. Energ.;* **23**: No. 4, 121-126(Apr 1977). (In Slovak).

The requirements are presented for the control properties of nuclear power plants in the USSR, USA and in Czechoslovakia and the possibilities of meeting the requirements are assessed with regard to the economy of nuclear power plant operation at variable load. The question is studied of how to achieve the same burnup in controlled operation as in the plant basic loading. The current types of PWR nuclear power plants do not meet the demand placed on sources operated at variable load. The desired properties of a nuclear power plant for control function satisfaction with sufficient economy may be attained by modifying the secondary coolant circuit (e.g., by the use of steam accumulators).

42720 Supports for the pressure vessel of a nuclear reactor. Crawford, J.D.; Pankow, B. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German(FRG) Patent 2,429,234/C/. 17 Mar 1977. 4p. (In German).

The supports described guarantee a safe position of a pressure vessel in all operating conditions, i.e. even in extreme incidents such as leaks or bursts in a main coolant line or for seismic effects. In normal operation it takes up thermal stresses. The supports consist, for example, of 4 vertical columns of rectangular crossection erected within the containment at intervals around the pressure vessel and anchored to the floor. Their long side is turned towards the pressure vessel. The columns can therefore deflect to the necessary extent for thermal forces. Their dimensions exclude the possibility of self-generated vibrations of the system due to seismic initiation. The pressure vessel is supported on the surrounding columns by suitable fasteners and fixed to these. Even large forces directed upwards to the vessel which may appear if the coolant floods the reactor pit, are taken up by the columns. The 4 pipelines with their pipe supports which are used for introducing and removing the coolant, act as fasteners. These pipework supports are welded to an upper part of the columns, which can be taken off.

42721 Steam generator. Reisacher, R. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,358,106/C/. 17 Feb 1977. 4p. (In German).

The patent is concerned with the even distribution of steam over the liquid separator in steam raising units with U-tubes standing on a tube plate. The efficiency or use of the separator is improved by the even distribution over the boiler cross-section. This is achieved by the installation of a guide surface between the space filled with U-tubes and the separator(s). This guide surface, consisting of a fixed part and a part which can be rotated about a horizontal axis, extends nearly over the whole width of the space filled with U-tubes. The guide surface, which is slightly inclined to the vertical, lies with its axis parallel to an imaginary separating surface between the cold and

warm legs of the U-tubes, but displaced towards the hot side. In this way the larger quantity of steam generated on the hot side of the U-tubes and the smaller quantity of steam generated on the colder side of the U-tubes are evenly distributed to the separator surface. In consequence, apart from better use of the separator or apart from the possibility of going to smaller dimensions, the pressure loss before the separator is reduced by the guide surface, with better stability of steam generation.

42722 Prediction of primary circuit contamination in power reactors. Beslu, P.; Pepin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Costa, L.; Frejaville, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). *Atomkernenergie;* **30**: No. 4, 297-302(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

Knowledge of the amount and distribution of activity in the coolant circuit of a power reactor is of great practical importance for determining shielding and for predicting operating personnel radiation exposure. The present status of mathematicals models to predict the contamination level in power reactor coolant circuits (High temperature, Fast breeder and Pressurised Water Reactors) are presented in this paper. Some applications are also given.

42723 Optimization of the condensate cleaner in the secondary circuit of nuclear power plants operating with pressurised water reactor. Nagy, O.; Hilt, L. (Villamosenergiaipari Kutato Intezet, Budapest (Hungary)). *Energ. Atomtech.;* **30**: No. 1, 1-7(1977). (In Hungarian).

The modalities of the secondary circuit condensate treatment are presented from the point of view of cooling water quality, tightness of the condenser and corrosion product in the case of a VVER-type reactor. Flow diagrams for condensate treatment are outlined and the optimization of the condensate treatment systems (determination of the recipient weight of the external regenerative system) provided with mixed-bed is examined as a function of unit number and ion exchange flow.

42724 Shielding design features of the floating nuclear plant. Billings, M.P.; Capo, M.A. (Offshore Power Systems, Jacksonville, Fla. (USA)). *Atomkernenergie;* **30**: No. 4, 244-248(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

The floating nuclear plant incorporates a number of shield design approaches that conserve weight and space, while meeting criteria applicable to onsite and offsite radiation exposures. Shield doors, variable-thickness shields, high-density materials, and a shielded fuel transfer crane are some of the weight- and space-saving techniques applied. Experimental data are used liberally to verify shield designs. System operations are specifically reviewed for their effects on shielding requirements. Scale models of shielding, and penetrations thereof, are routinely prepared and incorporated into models of the overall plant, especially component arrangements and piping layouts.

42725 Energy absorbing pressure release valve. (to Babcock and Wilcox Co., New York (USA)). Netherlands Patent 7,610,814/A/. 30 Sep 1976. Priority date 25 Mar 1976, United States of America (USA). 12p. (In Dutch).

The invention provides a pressure relief valve for the core support cylinder of a nuclear reactor vessel during failure or accident in the nuclear reactor system. The valve is responsive to differential pressure across the valve which in one direction sealably seats the valve plate against the valve body and which, in the other direction, opens the valve for pressure relief of the cylinder. Moreover, the valve is provided with energy-absorbing means which limit the impact load of an 'explosively' opening valve on the reactor vessel wall.

42726 Pressurized-water reactor. Schabert, H.P.; Helf, H. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,430,787/A/. 15 Jan 1976. 9p. (In German).

The invention concerns the facilitation of maintenance for the main-steam pipes of PWRs. The configuration described in the main patent no. 2345580 provides for mounting an isolating valve each within and outside the containment on the main-steam pipe leading out of the containment. It is further proposed to connect a safety valve, whose blow-down pipe terminates outside the containment, in series with the inner isolating valve. The new proposal now places this safety valve in the region outside the containment, but leaves it to be isolated by a valve lying inside. Further details are described.

42727 Nuclear power station with a WWER-440 reactor. Lewczuk, J. *Energetyka;* **30**: No. 1, 1-5(1976). (In Polish).

Nuclear power plant with WWER-440 reactor is presented. Technical reactor parameters are given. Primary and secondary coolant circuits are described. The scheme of electric system is given.

42728 Optimization of water regime of secondary circuits of nuclear power plants with WWER reactors. Margulova, T.Kh.; Prokhorov, F.G.; Ryabova, D.V. (Moskovskii Ehnergeticheskii Inst. (USSR)). *Teploenergetika (Moscow);* No. 7, 1-6(Jul 1974). (In Russian).

Feedwater was purified in the condensate polishing filters. Water conditions for the secondary loops of nuclear power stations with WWER type reactors for different condenser cooling waters were studied. Calculations for condensate treatment when using river cooling water are given. Condensate polishing supplemented with chelating agent treatment of the feedwater enables the reduction of heating surface of steam generators up to 20%.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 42704, 42722, 42849, 42850, 42981, 42982

42729 (N—78-11810) Materials science: high temperature materials. Kofstad, P. (Central Inst. for Industrial Research, Oslo (Norway)). 10 Mar 1976. Contract NTNF-B-1204.5702. 58p. NTIS PC A04/MF A01.

The main aspects of oxidation and carburization of high temperature alloys exposed in HTR helium atmospheres with impurities of H2, H2O, CO, and CH4 are summarized. The reaction behavior is discussed in terms of the thermodynamics and kinetics of the different oxidation and carburization reactions which may take place, and a tentative reaction mechanism is proposed. The main oxidizing reaction involves oxidation by water vapor, while the main reaction responsible for carburization is tentatively concluded to comprise the reaction between methane and carbon monoxide. On this basis the conditions for achieving minimum materials degradation by oxidation and carburization are discussed both in terms of alloy compositions and the relative amounts of impurities in the helium coolant.

42730 Process for fuelling a gas cooled high temperature nuclear reactor. Ferrari, G. (to Hochtemperatur-Reaktorbau G.m.b.H., Koeln (Germany, F.R.)). German(FRG) Patent 1,764,277/C/. 16 Jun 1977. 4p. (In German).

The claim relates to a process for the partial refuelling and fuel discharge of a pebble bed reactor. To separate various groups of fuel elements, the reactor core is divided into several spaces by vertical walls, which all have their own refuelling and fuel discharge equipment. The spaces are supplied with fuel and breeding elements, which have experienced different numbers of cycles, or each fuel element passes through several spaces in sequence. The purpose of this process is as even a load density as possible, or even burn-up. The application of the process requires a burn-up measuring equipment.

42731 Fuelling machine for nuclear reactors with coated pellet fuel elements. Schoening, J.; Landwehr, H.; Handel, H. (to Hochtemperatur-Reaktorbau G.m.b.H., Koeln (Germany, F.R.)). German(FRG) Patent 1,589,532/C/. 12 May 1977. 6p. (In German).

The claim relates to the construction and arrangement of parts of a fuelling machine for the dosed transmission and distribution of spherical fuel elements. The device is assembled from hexagonal, prismatic blocks like an assembly of prefabricated machine parts, so that parts are easily interchangeable. The blocks, having the same external dimensions and a through hole of the same diameter for a pneumatically operated lifting piston, contain all the connecting holes required for various functions, so that no intermediate pipework is required for prisms arranged close together in space.

42732 Future developmental trends of HTGR power plants. Polak, E. *Jad. Energ.;* **23**: No. 3, 108-112(Mar 1977). (In Czech).

The results are reported of HTGR advanced system studies and the significance thereof for the energy problem solution is shown after: Fortescue, P.: Advanced HTGR systems, Annals of Nuclear Energy 2, 1975; 11/12, pp. 787-799.

42733 From the age of oil fuel system to HTGR and hydrogen energy system. Umano, S. *Genshiryoku Kogyo;* **23**: No. 3, 9-30(Mar 1977). (In Japanese).

To substitute the overall energy demand with nuclear energy, the means with high temperature gas-cooled reactors is an absolute alternative. In the combination of this type with hydrogen as a new energy vector, the advent of a hydrogen energy system then takes over the current system of fossil fuels. Concerning this future trend, not only the technology but also the economic and social perspectives are treated. Through the considerations as described above, the conception of a gigantic hydrogen center was formed. Explanation proceeds as follows: switching of energy sources, availability of nuclear fuel resources, problems of high-temperature gas cooled

reactors, the necessity for a hydrogen system, and a giant hydrogen center.

42734 Core construction for nuclear reactors. Pettinger, D.S. (to Nuclear Power Group Ltd., Knutsford (UK)). German(FRG) Patent 1,639,361/B/. 3 Feb 1977. 8p. (In German).

The purpose of this graphite moderated core construction is the unloading of the outer support construction of the core regarding horizontal support forces, which would otherwise have to be provided against bending of individual blocks due to the effects of temperature and radiation. These blocks assembled in vertical columns have through holes for accommodating fuel or control rods or for hollow spaces for this purpose with the surrounding adjacent columns. By suitable construction of the upper and lower horizontal surfaces which form the boundary of each prismatic block, inherently mutually cancelling forces are produced. These surfaces (or at least one of them) are not made even, but have spherical indentations. The centre of the sphere lies outside the block on the far side of the opposite surface, but not on the vertical axis of symmetry of the block but to one side. By suitable choice of the sphere radius and the position of its centre point the internally cancelling forces required are produced due to the effect of gravity on the blocks above. Any partial shrinkage of individual blocks is made ineffective or prevented in this way. The vertical expansion of columns and the fuel and control channels between them remains stable in operation.

42735 Accuracy analysis in HTR nuclear design. Watanabe, T.; Nakata, T.; Ooka, T.; Tanaka, R. (Kawasaki Heavy Industries Ltd., Kobe (Japan)). *FAPIG (Tokyo);* No. 84, 2-7(Feb 1977). (In Japanese).

The nuclear design of very high temperature reactors(VHTR) requires higher accuracy from the viewpoints of not only reactivity control but also the limit temperature of fuel and the decrease of the release of fission products as the design goes more and more in detail. Under this consideration, the accuracy analysis in the VHTR nuclear design was conducted. The analysis results show that the key to the accuracy of design depends upon the analytical accuracy around the central element including void streaming, and also the improvement of the accuracy of cross section evaluation in the moderation-resonance region is essential, through the model for analyzing experiment must be investigated further regarding the nuclear cross section used for the design. The subject of investigation of this paper is VHTR which is at the design stage conducted by the Japan Atomic Energy Research Institute. Several assumptions adopted for this analysis especially regarding the design model and the nuclear data used for the design, the effect of fuel heterogeneity, the accuracy of analyzing burnable poison, and the homogenization of graphite blocks are described. The analysis of critical assembly experiments by GA company and JAERI is added and evaluated.

42736 Method for the removal of tritium from gas-cooled nuclear reactors, with the exception of reactors cooled with carbon dioxide. Nieder, R. (to Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Duesseldorf (Germany, F.R.)). German(FRG) Patent 2,237,506/C/. 26 May 1976. 4p. (In German).

The removal of tritium from the primary circuit of gas-cooled graphite-moderated nuclear reactors is achieved according to the invention by feeding hydrogen of hydrogen-contained compounds (preferably gaseous: CH_4, NH_3) into the primary circuit. Hence the tritium which is especially adsorbed by graphite is set free and is then led off in a by-pass in a known manner and is removed from the cooling gas by a purification plant. Intermittent feeding increases the purification effect.

42737 Possibility of high temperature reactors utilization in chemical technology. Ledakowicz, S. (Politechnika Lodzka (Poland)). *Chemik;* **29**: No. 3, 82-86(1976). (In Polish).

Present state of investigations on the waste-heat utilization from high temperature gas-cooled reactors (HTGR) is presented. More long is the gasification of coal and steam reforming of methane discussed. New conceptions of energetic economy basing on the hydrogen as the energy carrier are signalized.

42738 Fuel element for a gas cooled reactor. Koike, H. (to Kawasaki Heavy Industries Ltd., Kobe (Japan)). Japanese Patent 1977-67484/A/. 1 Dec 1975. 4p. (In Japanese).

A method to obtain uniform and reliable cooling of fuel elements is described. In a fuel element of the type in which a covered particle fuel is directly sealed within an annular container provided with slits and also in which cooling gas is caused to flow from an outside annular flow path to the inside flow path, the cooling gas is caused to uniformly pass through the covered particle fuel extending from the inlet to the outlet of the reactor core by providing protuberances on the inner surface of the cell forming the gas path or arranging such as to invert the flow of the inner side flow path.

42739 Critical heat fluxes in tubular fuel elements of nuclear power reactors. Subbotin, V.I.; Alekseev, G.V.; Peskov, O.L. *Teploenergetika (Moscow);* No. 9, 24-29(Sep 1974). (In Russian).

The results of the experiments carried out show that with appropriate choice of tube, type and dimensions of intensifier the attainment of critical conditions at certain parameters is not accompanied by sharp or considerable increases in temperature of the heat removing surface. Increase in power to above critical under these conditions does not lead to considerable variation in temperature either. Thus, it appears possible to change from heat removal by steam-water mixture to convective heat removal by wet steam without manifestation of intolerable temperature conditions of the heating surface (Fig. 6). A change to convective heat removal by wet steam is possible at different levels of heat fluxes which depend during constant conditions at the inlet on tube length and the degree of the disturbing influence on the flow. This is especially important since in principle the possibility arises for developing a power reactor with tubular fuel elements, in which a once-through cycle with steam superheat involving no intermediate separation can be realised.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 42925, 42931, 42935, 42938

42740 (AECL—5832) **Heat exchanger tubing materials for CANDU nuclear generating stations.** Taylor, G.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1977. 16p. (CONF-770399—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 22. nuclear congress; Rome, Italy (24 Mar 1977).

The performance of steam generator tubing (nickel-chromium-iron alloy in NPD and nickel-copper alloy in Douglas Point and Pickering generating stations) has been outstanding and no corrosion-induced failures have occurred. The primary coolant will be allowed to boil in the 600 MW (electrical) CANDU-PHW reactors. An iron-nickel-chromium alloy has been selected for the steam generator tubing because it will result in lower radiation fields than the alloys used before. It is also more resistant than nickel-chromium-iron alloy to stress corrosion cracking in the high purity water of the primary circuit, an unlikely but conceivable hazard associated with higher operating temperatures. Austenitic alloy and ferritic-austenitic stainless steel tubing have been selected for the moderator coolers in CANDU reactors being designed and under construction. These materials will reduce the radiation fields around the moderator circuit while retaining the good resistance to corrosion in service water that has characterized the copper-nickel alloys now in use. Brass and bronze tubes in feedwater heaters and condensers have given satisfactory service but do, however, complicate corrosion control in the steam cycle and, to reduce the transport of corrosion products from the feedtrain to the steam generator, stainless steel is preferred for feedwater heaters and stainlss steel or titanium for condensers.

42741 (AECL—5914) **Confirmation of CANDU shutdown system design and performance during commissioning.** Dastur, A.R.; Kugler, G.; Rouben, B.; Li, H.Y.H. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Oct 1977. 17p. (CONF-770708—17). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Thermal reactor safety meeting; Sun Valley, ID, USA (31 Jul 1977).

Spatially-dependent power transients during shutdown-system operation are calculated for a CANDU reactor. The computer code used is based on the improved Quasistatic method. Various calculations of static reactivity and flux distribution are also performed. Comparison is made to results of dynamic and static tests carried out during commissioning of the Bruce A G.S. The agreement between simulations and experiment confirms the predicted magnitude of the major factors influencing spatial kinetics in CANDU reactors.

42742 Manufacture of CANDU reactors. Sanders, A.J.E. (Dominion Bridge Co. Ltd., Montreal, Quebec (Canada)). *Met. Constr. Br. Weld. J.;* **10**: No. 1, 27-31(Jan 1978).

The major technologies used in the production of a Candu reactor are highlighted. The design and construction of a uranium, deuterium oxide moderated, pressure tube reactor system are outlined. The manufacture of end-shields, support rings and the calandria shell, and their assembly, are described. The inner and outer tubesheets and the shell, made of 304L stainless steel, are manufactured using TIG and electroslag welding. The support rings, made of carbon steel, are welded to the vessel using ER309L electrodes to reduce delta ferrite formation. Quality control, service requirements and metallurgical problems are considered.

42743 Nuclear reactors. Middleton, J.E. (to Nuclear Power Co. (Whetstone) Ltd. (UK)). British Patent 1,491,232/A/. 9 Nov 1977. 11p.

Reference is made to water cooled reactors and in particular to the cooling system of steam generating heavy water reactors (SGHWR). A two-coolant circuit is described for the latter. Full constructural details are given.

42744 Consideration in the design and fabrication of nuclear heat exchangers. Ajeet, J.B.; Asundi, A.K.; Jagadishan, P. (Department of Atomic Energy, Bombay (India). Power Projects Engineering Div.). *Indian Chem. Manuf.;* **15**: No. 10, 1-3(Oct 1977).

The design and fabrication requirements, non-destructive examination and testing of nuclear heat exchangers in CANDU type pressurised heavy water cooled power reactors are described. Attention has been drawn to the stringent requirements for material selection, the need for dust-free conditions during welding operations, the special technique and stringent quality control associated with the 'tube to tube-sheet welding' and the 'non-destructive testing' requirements. In the case of steam generators, an additional requirement that has been highlighted is their capability to withstand various transient conditions occuring during operation of the reactors.

42745 Manufacture and installation of coolant recirculation facility for advanced thermal prototype reactor 'Fugen'. Komino, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Inoue, N. *Doryokuro Giho;* No. 22, 41-68(May 1977). (In Japanese).

The reactor coolant-recirculating system removes the heat generated by fuel assemblies, separates steam and water, and supplies the steam to the turbine while supplies the water to the reactor core again by mixing it with feed water. The system is divided into two independent loops connected to each region of the halved reactor core. The reactor coolant-cleaning system removes corrosion products and other impurities in primary coolant and maintains water quality. The system for injecting and draining sealing water for recirculating pumps is installed also. The construction and the design of the steam drums, lower headers, recirculating pumps and the main pipings for the recirculating system are explained. The equipments and pipings for these systems were designed, manufactured and installed by Mitsubishi Heavy Industries, Ltd., and almost completed in October, 1976, except the synthetic pressure test of the primary cooling system scheduled in August, 1977. The manufacture of the main equipments, the arrangement and the methods of supporting and restriction of the systems, and the installation are explained. Strict quality control was carried out on the installation and welding, especially to prevent the stress corrosion cracking of stainless steel and to prevent leaving foreign matters in enclosed equipments.

42746 Mock-up of pressure tube monitoring apparatus for the prototype heavy water moderated boiling light water cooled reactor 'Fugen'. Naruo, K. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center); Shibato, E.; Suzuki, K. *Hitachi Hyoron;* **59**: No. 4, 295-300(Apr 1977). (In Japanese).

The pressure tube assembly for the prototype heavy water-moderated, boiling water-cooled reactor "Fugen" is equivalent to the reactor vessels for light water reactors, and very high reliability is required. Therefore the in-service inspection becomes very important as one method improving the reliability. The mock-up of pressure tube monitoring apparatus was manufactured, considering the special structure and material, for the purpose of developing the device for in-service inspection of the pressure tube assembly. It was recognized that the application to the actual reactor with sufficient accuracy is possible, as the results of the volumetric inspection using ultrasonic method, the inspection of internal surfaces with a borescope and an ITV, and the measurement of the inner diameter and inclination of pressure tubes with linear variable type and pendulum type differential transformers under the conditions simulating the application to the actual reactor.

42747 Manufacture and installation experience of pressure vessel for the prototype heavy water moderated boiling light water-cooled reactor 'Fugen'. Shibato, E.; Oguchi, I.; Kishi, T.; Koyama, T.; Kitagawa, Y. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works). *Hitachi Hyoron;* **59**: No. 4, 289-294(Apr 1977). (In Japanese).

The time schedule of the prototype heavy water-moderated, boiling light water-cooled reactor "Fugen" in Japan is to complete the installation of components in the middle of 1977 and to achieve the criticality in March, 1978, after conducting the many kinds of functional tests. Many research and development works were carried out in advance of the construction of the reactor itself, as the structure and the material of the reactor "Fugen" are entirely different from those of light water reactors. The manufacture of the reactor has been completed already on the basis of the results, and the installation work is under way smoothly at present. The example in which the results of the research and development works were fed back very effectively to the manufacturing and installation of the reactor, the noteworthy items in the field of production technology in the manufacturing and installation and so on are described in this report.

42748 Prospects for manufacturing industry. Monier, L.F.; Carbonneau, R. (Hydro-Quebec, Montreal (Canada)). pp 32 p. of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976. Vol. 1, No. 2, Session III, Paper 1. Godbout, P.J.; Amyot, L. (eds.) (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire). Montreal, Canada; Ecole Polytechnique (Jan 1977). (In French)

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

After an overview of projected nuclear construction in Quebec, a detailed breakdown is given of Canadian, Quebecois, and imported content in a CANDU nuclear power station.

42749 Market for nuclear equipment - engineering and fabrication. Tait, D.R. (CAE Electronics, Montreal, Quebec). pp 10 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976. Vol. 1, No. 2, Session III, Paper 3. Godbout, P.J.; Amyot, L. (eds.) (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire). Montreal, Canada; Ecole Polytechnique (Jan 1977).

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

The role of electronic equipment in a CANDU power station is explained. Costs of installations and outages are outlined. The nuclear market for electronic equipment utilizes many components common to non-nuclear applications.

42750 Fuel assembly for a pressure tube type heavy water reactor. Ueda, M. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-61697/A/. 17 Nov 1975. 5p. (In Japanese).

A method to conveniently switch the void coefficient of coolant to negative side to flatten power distribution within the fuel assembly is described. A plurality of water sealing rods with light water sealed therein or other moderator rods are symmetrically and dispersedly arranged, in place of fuel rods, about the axis of the core so as not to almost produce void within a pressure tube. In the fuel assembly constructed as described above, the infinite multiplication constant will not be increased even in the vicinity of 100% of rate of void.

42751 Reactor fuel assembly. Komata, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-46292/A/. 8 Oct 1975. 3p. (In Japanese).

A method to prevent damage to the fuel by cancelling the coolant retention effect due to the spacer through production of a turbulent flow in the coolant is described. The flow path of the coolant is divided by providing a coolant flow path division tube which has an opening within the pressure tube. Part of the coolant flowing through the inside (or outside) of the flow path division tube is discharged through said opening to the outside (or inside) of the tube to thereby cause the turbulent flow.

42752 Reactor. Takeda, R. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-43092/A/. 1 Oct 1975. 4p. (In Japanese).

A method to eliminate wasteful absorption of neutrons by the control rod by increasing the average power density of the core is described. The inter-grid interval of the fuel assembly especially of HWLWR type reactors is reduced in the central portion of the reactor to thereby reduce the effective multiplication factor, while at the same time it is increased in the edge portion of the reactor to increase the effective multiplication factor. In this way, the power distribution is flattened.

42753 Fuel transporting device in nuclear reactor. Inoue, T. (to Fuji Electric Co. Ltd., Tokyo (Japan)). Japanese Patent 1977-41792/A/. 29 Sep 1975. 5p. (In Japanese).

A method to obtain a support structure of an excellent quakeproof property for a fuel transporting device provided for the transportation of fuel between a reactor building and an auxiliary building in a pressure tube reactor or the like is described. The structure comprises an oblique transfer chute loosely penetrating the reactor building, reactor container and auxiliary building, a transfer chute support outer cylinder surrounding the transfer chute and having one end coupled to the transfer chute and other end coupled to the container, flexible seal members respectively provided on the reactor building side and on the auxiliary building side and surrounding the transfer chute and a slidable support supported on the side of the auxiliary building such that it can be in frictional contact with the outer periphery of the transfer chute. With this construction, the relative displacements of various parts caused by an earthquake or

the like can be absorbed by the support outer cylinder, flexible seals and slidable support.

42754 Quality assurance. Caillibot, P.F. (Hydro-Quebec, Montreal (Canada)). pp 19 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session II, Paper 5. Montreal, Canada; Ecole Polytechnique ([nd]). (In French)

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

The philosophy and specifications of four major Canadian nuclear component quality assurance standards are given.

42755 Mechanical components market. Perryman, E.C.W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 20 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session III, Paper 2. Montreal, Canada; Ecole Polytechnique ([nd]).

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

Evolution of CANDU power station design is described and installed nuclear power in Canada to 2000 is forecast. The predicted value of various mechanical components is depicted. Improvements are being made in reliability and speed of repair, which reduce man-rem expenditure in concert with radiation field reduction. Actual reactor operating performance is very good; a significant portion of power plant downtime is associated with steam turbine and generator unreliability. Heavy water upkeep has been reduced by improved equipment layout, live loading of valve stem packing, improved flange seals, and improved leak detection techniques. Steam generator tube reliability is 1000 times better than that of light water reactors. Pump seal reliability has progressed to the point that current station design eliminates pump redundancy. Fuel bundle defect rates are now less than 0.03%.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 42704, 42722, 42832, 42835, 42852, 42901, 42924, 42932, 42936, 42939, 42943, 42966, 42977, 42983, 42987, 43009, 43025, 43029, 43034, 43038, 43118, 43857

42756 (AI-DOE—13232) **Cover gas seal components and sodium component development programs. Quarterly technical progress report, January—March 1978.** (Atomics International Div., Canoga Park, Calif. (USA)). 30 Apr 1978. Contract EY-76-C-03-0824-011. 18p. AT.

Progress is reported in the following study areas: CRBRP inflatable seal vendor qualification, static inflatable seal development, high-temperature seal degradation, and sodium wetting tests on specimen materials.

42757 (ANL-CT—78-5) **Measurement of the sound produced during steam injections into sodium.** Claytor, T.N.; Carey, W.M.; Doolittle, R.D.; Fitzgerald, J.W. (Argonne National Lab., Ill. (USA)). Sep 1977. Contract W-31-109-ENG-38. 86p. AT.

The acoustic signature of a steam-into-sodium leak has been investigated. Characterization of the acoustic signal from a leak of steam into sodium is of interest because a steam leak in a liquid metal steam generator module has potential for dire economic consequences if allowed to grow into a larger-size leak by self-wastage and impingement damage. Passive acoustic monitoring of the steam generator module may have the capability to rapidly detect a steam-to-sodium leak in a liquid metal fast breeder reactor steam generator module. Data contained in the report clearly show that at higher frequencies (> 20 kHz) a larger signal-to-noise ratio was obtained than at frequencies below 10 kHz under conditions of half the maximum sodium flowrate for a prototypic liquid metal steam generator. Characteristic of the steam-to-sodium leak was a form of acoustic energy release which occurs in intense bursts with frequency components of up to 100 kHz. This feature of the sodium-to-steam injection may enable detection of leaks with simplified instrumentation or improved response time by using steam leak signals in the frequency range above 20 kHz. At lower frequencies, the acoustic energy released was probably due to hydrogen bubble oscillation, thus substantiating previous suggestions that hydrogen bubble oscillation is the dominant source of sound at low frequencies (2 kHz).

42758 (ANL-CT—78-16) **PLENUM-2: a two-region outlet plenum model.** Howard, P.A.; Carbajo, J.J. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 93p. AT.

An experimental study to address the transient behavior of a generalized outlet plenum after a scram in a LMFBR has been conducted. Different conditions of flowrate, temperature, and geometries were used for three-exit loop-type reactor systems. Water was used as a fluid and a small-scale model plenum was used to simulate the various generalized configurations. Thermocouples were used to monitor the temperatures at 48 locations within the outlet plenum. The thermo-hydraulic behavior has been studied in detail and has been simplified as having four consecutive discrete stages. A computer model following these experimentally observed stages has been developed and calculations and results are compared.

42759 (CEA-CONF—4014) **Fundamental aspects of the evolution of, and phase changes in, metals and alloys under irradiation.** Martin, Georges; Bocquet, J.-L.; Barbu, Alain; Adda, Yves. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 6 Jun 1977. 16p. Dep. NTIS (US Sales Only), PC A02/MF A01.

From International conference on radiation effects in breeder reactor structural materials; Scottsdale, AR, USA (19 Jun 1977).

The quantitative prediction and the simulation of irradiation damage present a considerable interest for the technology of fast neutron and fusion reactors. However, at present time, even qualitative predictions are not always possible when the dose rate varies over a relatively large range; for example the formation of vacancy loops takes place instead of that of voids, precipitation occurs in under-saturated solid solutions etc... Therefore, in addition to a microscopic description of the phenomena, it seems important to elaborate an irradiation damage phenomenology. The results of a systematic experimental study of dose rate effects for radiation induced precipitation in Ni Si solid solution alloys are reported. The existence of dose rate thresholds for this phenomenon is clearly established. The composition dependence of this thresholds permits the definition of a solubility limit under irradiation which is both temperature and dose rate dependent. Finally, the various theoretical approaches to radiation induced precipitation are discussed.

42760 (COO—2250-31) **MIT LMFBR Blanket Research Project. Quarterly progress report, October 1, 1977—December 31, 1977.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1977. Contract EY-76-S-02-2250. 16p. Dep. NTIS, PC A02/MF A01.

Research progress on LMFBR breeding blanket is reported for the following: threshold foil traverses in blanket/reflector Mockup 5B, Mockup No. 6 assemblies, and LCCEWG benchmark problems.

42761 (COO—2826-7) **Fast Breeder Blanket Facility (FBBF). Annual report, January 31, 1976—December 31, 1977.** Ott, K.O. (ed.). (Purdue Univ., Lafayette, Ind. (USA). School of Nuclear Engineering). Jan 1978. Contract EY-76-S-02-2826. 85p. (PNE—78-127). Dep. NTIS, PC A05/MF A01.

The work performed in the reporting period was primarily concerned with the construction of the Fast Breeder Blanket Facility (FBBF), acquisition of experimental equipment, outlining the experimental program, preanalysis of the initial loading configuration and investigation of the safety of the initial loading and advanced loadings. The detailed physical description of the FBBF, operational procedures and controls, radiation shielding and experimental equipment are presented. The ability of the FBBF to simulate the blanket spectrum of a large fast breeder reactor is illustrated by comparison of spectra. The source axial distribution, reaction rate comparisons, breeding of plutonium and gamma-ray energy deposition rates are also discussed. Some of the safety aspects of the initial loading and advanced loadings are described. Experimental capabilities of the facility are outlined.

42762 (FE—2044-23) **Partial liquefaction of coal by direct hydrogenation. Annual report, August 1976—July 1977.** Oberg, C.L.; Falk, A.Y.; Friedman, J. (Rockwell International Corp., Canoga Park, Calif. (USA). Rocketdyne Div.). Dec 1977. Contract EX-76-C-01-2044. 72p. Dep. NTIS, PC A04/MF A01.

This report describes progress made on a program to develop a process for partial liquefaction of coal, based on the "flash hydropyrolysis" concept, in a high-mass-flux, short-residence-time reactor. Results from the first year of the program are summarized. Successful reactor tests have been carried out at nominal coal flowrates of 1/4- and 1-ton/hour (tph) with a caking western Kentucky coal without pretreatment. Twenty-one 1/4-tph and 24 1/tph tests have been made. Up to 1500 lbm of coal has been processed in a single test with test durations up to 1 hour. Overall carbon conversions consistent with the requirements for a commercial plant (when char is used to produce the process hydrogen) have been achieved. Favorable quality liquid and gaseous products have been obtained. Vapor-phase liquid-product recovery has been achieved, so that no filtration is required. A fine, dry char suitable for direct feeding to a hydrogen generator is obtained. Carbon recoveries of 94% have been achieved in short-duration tests. The reactor system is functioning very well. Plans for the next 2 years of the program are outlined.

42763 (GEFR—00274(L)) **Plugging/unplugging of defects in LMFBR steam generator tubing.** Pellow, H.C. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1977. Contract EY-76-C-03-0893-010. 30p. AT.

An investigation was made to (1) determine the plugging tendency of small leaks/defects in steam generator tubing material when exposed to simulated manufacturing and testing techniques, and (2) determine the ability of a candidate plant cleaning solution to dissolve the plug and open the leak. Nine series of four leaks each (leak sizes ranging in equivalent steam flow rate from 1.34×10^{-5} to 1.2×10^{-1} grams/sec) were exposed to: humid storage with VPI addition, die lubricant, heat treatment, hydrotest, dye penetrant examination, sodium exposure, centerless grinding lubricant and sodium-water reaction products. Severe reduction in leak flow in almost all cases resulted from exposure to the various processes, with complete plugging of about $\frac{1}{3}$ of the leaks. Cleaning of the defects with a 4% citric acid solution containing 0.1% Rodine 33, at a pH of 3.0 to 4.0 and a temperature of 160°F (71°C) resulted in the opening of all the leaks tested (including those completely plugged) to the same order of magnitude as the large leaks in the series. The use of such a cleaning solution following tube fabrication, before operation of a steam generator, and/or after a leak has been detected but subsequently plugged, appears to be feasible. Additional work in this area is recommended to provide the operational techniques required.

42764 (GEFR—00303) **Fatigue crack growth properties of type-316 plate and 16-8-2 stainless steel welds in air and high carbon liquid sodium.** Copeland, J.F.; Yuen, J.L. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1977. Contract EY-76-C-03-0893-031. 119p. TIC $6.50.

The fatigue crack growth rates of Type 316 stainless steel and 16-8-2 GTA welds were measured in air and high-carbon liquid sodium at 510°C (950°F) for secondary sodium loop LMFBR applications. Loading variables such as low frequency, load ratio, and hold-time at peak load were studied. Crevice experiments were performed, and a diffusion model for carburization in a crack was developed. The results show that carburization of crack faces occurs prior to any crack tip carburization for up to 5 to 15% of a 2.1×10^5 hr. service life, with practical crack sizes and load frequencies. Thus, a carburization effect on da/dN is not shown for the relatively short-term tests of this study. Low ΔK, ultra-low frequency tests to simulate service would be required to show this effect. These tests appear to be very time consuming. It is recommended that Nuclear Systems Materials Handbook (NSMH) crack growth curves for austenitic stainless steels in air, with appropriate frequency and load ratio corrections, should be conservative for design against crack extension in high-carbon sodium, for base metal and welds. Verification of this recommendation by possible ultra-low frequency testing and long-time exposure of surveillance crevice specimens under service conditions is also recommended.

42765 (GEFR—00349) **Hydraulic testing program on vented assembly core design.** Wang, J.C.F. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Mar 1978. Contract EY-76-C-03-0893-031. 73p. AT.

Early LMFBR vented core hydraulic studies demonstrated that vent and interstitial flows are primarily governed by the vent and load pad plane flow resistances. The methods used to evaluate the magnitude of these resistances were very simplified and thus lead to large uncertainties in the vent and interstitial flow patterns. To reduce the largest of these uncertainties, an analytical and test program was initiated in FY-77 to provide better flow resistance correlations with empirical verifications for (1) flow through vents, (2) flow past load pads, and (3) radial flow between assemblies. This program was completed by the end of FY-77 and the report completes the documentation.

42766 (GEFR—00353) **Characterization of CRBRP steam generator shell plate.** Offer, H.P.; Ring, P.J. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Mar 1978. Contract EY-76-C-03-0893-030. 58p. AT.

A section of CRBR steam generator shell plate was evaluated in the fully annealed and annealed plus post weld heat treatment (PWHT) conditions. The microstructural features were determined to provide a more complete understanding of the influence of the structure on the mechanical properties which were subsequently characterized. The results of these mechanical property tests have been compared to the mechanical property guidelines used for design purposes, which in most cases were based on data from material with nonprototypic anneals and without PWHT. The results of this evaluation are presented.

42767 (GEFR—13771-25) **Critical experiments and analysis.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). 1977. Contract EY-76-C-03-0893-031. 64p. AT.

Current activities and technical progress are reported for two subtasks. Subtask A covers the technical direction for critical experiments and analysis as applicable to LMFBR commercial plants and the Clinch River Breeder Reactor Plant Benchmark Critical Experiments in ZPPR Assembly 4 and the CRBRP EMC. Subtask B is directed towards the analysis of advanced fuels critical experiments that can provide a consistent data base for testing the computational tools, nuclear analysis techniques and basic nuclear data which are used in the LMFBR design effort, and for evaluating the nuclear performance and safety characteristics of advanced fuel materials.

42768 (GEFR—14031-11) **Core restraint engineering. Eleventh quarterly report, February—April 1977.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). May 1977. Contract EY-76-C-03-0893-023. 35p. Dep. NTIS, PC A03/MF A01.

The objective of the work reported is to develop, in conjunction with other members of the National Core Restraint Development Program, the design guidelines and the corresponding technology required to design LMFBR core restraint systems and to support applicable licensing processes. Progress during the reporting period is described for subtasks related to refueling force evaluation and test, instrumented simulated fuel assemblies, core restraint transient analysis, in-reactor monitoring, advanced core restraint studies, and seismic evaluation.

42769 (IAEA-AG—63-12) **Perspectives of the nuclear power development in the USSR and the strategy of fuel reprocessing.** Dergachev, N.P. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 10p. (In Russian). (CONF-760576—34). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

The forecast of the USSR program for nuclear power development, the role of fast reactors, the time of their introduction and their effect on fuel cycles are treated in the paper together with the consideration of technical characteristics of different fast reactors and their effect on uranium demand. The basic principles of development of reprocessing capacity is also described.

42770 (INIS-mf—4052, pp 57-59) **Fast-core thermal-blanket breeder reactor.** Schneider, A.; Greenspan, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). 1977.

From Meeting of the Israel Nuclear Societies Technion; Haifa, Israel (4 Dec 1977).

In Transactions of the Nuclear Societies of Israel. Vol. 5.

A preliminary assessment of the performance expected from a specific type of FCTB reactor, consisting of a gas-cooled fast system for the core and natural-uranium light-water thermal system for the blanket is reported. Both the core and the blanket use the ^{238}U-Pu fuel cycle. When all the neutrons leaking out of the core reach the blanket, the blanket-to-core power ratio is estimated to be about 1.3. By reducing its water-to-fuel volume ratio below 1.5, the light water blanket can be designed to have a higher ksub(eff), while maintaining an equilibrium fissile fuel content. Compared with conventional FBRs, having the same power output, the FCTB reactor considered offers the following advantages: a lower fissile fuel content, easier and safer control, no need for Pu separation.

42771 (IWGFR—10, pp 57-71) **Ultrasonic testing of austenitic components of sodium cooled fast reactors.** Neumann, E.; Kuhlow, B.; Roemer, M.; Matthies, K. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

A special ultrasonic technique for testing austenitic steel components of sodium cooled fast reactors under conditions of strong gamma activity and high temperature is described.

42772 (IWGFR—10, pp 9-23) **Proposal for in-service inspection and monitoring of selected components located within or part of the primary containment of sodium cooled fast reactors.** Bolt, P.R. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Design and operational experience of CEGB gas cooled reactors and certain overseas reactor plant is reviewed in relation to in-service inspection and monitoring of selected components located within or part of the primary containment of sodium cooled fast reactors. Specific comments are made on the items of further design and development work believed to be necessary.

42773 (IWGFR—10, pp 71-73) **Ultrasonic testing, state of the art and possible developments.** Haesen, W.; Tromp, Th.J. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Ultrasonic testing is considered today as an important method for in-service inspection of the LMFBR type reactor components. A survey is made on what is available to the manufacturers of reactor components.

42774 (IWGFR—10, pp 86-93) **Television/still camera with common optical system for reactor inspection.** Hughes, G.; McBane, P. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

One of the problems of reactor inspection is to obtain permanent high quality records. Video recordings provide a record of poor quality but known content. Still cameras can be used but the frame content is not predictable. Efforts have been made to combine T.V. viewing to align a still camera but a simple combination does not provide the same frame size. The necessity to preset the still camera controls severely restricts the flexibility of operation. A camera has, therefore, been designed which allows a search operation using the T.V. system. When an anomaly is found the still camera controls can be remotely set, an exact record obtained and the search operation continued without removal from the reactor. An application of this camera in the environment of the blanket gas region above the sodium region in PFR at 150°C is described.

42775 (IWGFR—10, pp 26-35) **In-service inspection for "Monju".** Abe, S. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

In-service inspection equipment for Liquid Metal Fast Breeder Reactors will be located in many cases in a limited space with high irradiation and high temperature. Design and research of in-service inspection for MONJU is introduced as follows: Inlet pipe of reactor vessel; Reactor vessel; Heat transfer tubes of IHX; Heat transfer tubes of steam generator. The test result is reported.

42776 (IWGFR—10, pp 43-50) **Inspection requirements and concepts for LMFBR heat exchangers and pump. A manufacturers view.** de Boer, G.A.; Tromp, Th.J. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

This paper deals with inspection requirements and concepts for liquid metal fast breeder reactor heat exchangers, steam generators and sodium pumps. Improvement of the on-load surveillance methods are specifically recommended. A chart on the levels of inspection is given.

42777 (IWGFR—10, pp 100-116) **In-service inspection and monitoring of LMFBR in France.** Bret, A.; Gallet, B.; Tomachevsky, E. Jul 1976. (In French).

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

In France, the control and monitoring of the LMFBR type reactor is achieved by: temperature, fluxes and reactivity measurements; sodium leakage detection; ultrasonic testing methods; mechanical deformation and stress analysis.

42778 (IWGFR—10, pp 117-122) **Development of acoustic monitoring techniques of LMFBRs.** Burtun, E.J. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Manufacturing defects may be identified by ultrasonic inspection or by stress wave emission. Mechanical failures arising from maloperation may be detected by visualisation under sodium using ultrasonics. Mechanical failures arising from material loss by corrosion or erosion may be anticipated by the detection of acoustic events. Overheating leading to core damage may be detected from the noise of sodium boiling. Mechanical failure from fatigue may be anticipated from an understanding of the vibrational modes of the sodium and its coupling with the structure.

42779 (IWGFR—10, pp 132-139) **An-approach to the on-load surveillance of sodium cooled reactors by acoustic methods.** Foerster, K. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Among a number of various tasks which are partially more conventional or in a similar way valid for other types of reactors, three topics were thought worth while to be considered for the development of acoustic control systems for fast reactors: 1) sodium boiling detection in reactor core, 2) detection of sodium-water reactions in steam generators and 3) crack detection by stress wave emission analysis.

42780 (IWGFR—10, pp 150-157) **Radiographic and ultrasonic inspection of an austenitic pump barrel.** Haesen, W.; Klinkert, G.F.; Tromp, Th.J. (Neratoom N.V., The Hague (Netherlands)). Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Volumetric testing of the welds of a radioactive pump barrel poses quite a few problems. This paper describes the series of preliminary tests for the sodium pumps of SNR-300. The tests involved were: Ultrasonic; radiografic.

42781 (IWGFR—10, pp 35-42) **In-service inspection at the SNR 300 with the range of reactor vessel.** Leder, H. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

A general view of the in-service inspection situation of the SNR 300 within the reactor vessel is given. Specification instructions and recommendations, including the licensing procedure, are shown.

42782 (IWGFR—10, pp 79-84) **Studies in non-destructive testing with potential for in-service inspection of LMFBRs.** McClung, R.W. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

A variety of nondestructive examination techniques have been and are being developed at ORNL with potential for ISI (In Service Inspection) in LMFBRs. Among these are radiographic techniques for radiation environment and image enhancement, advanced eddy-current techniques and equipment for flaw detection and thickness measurement and ISI of steam generator tubing, and ultrasonic methods for quantitative flaw evaluation using frequency-analysis and bore-side ultrasonic techniques for steam generator tubing. Further developments should result in positive application to ISI.

42783 (IWGFR—10, pp 144-146) **Vibration-acceleration measurements on prototype steam generators.** Tromp, Th.J. (Neratoom N.V., The Hague (Netherlands)). Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

Vibration-acceleration measurements on prototype steam generators of the sodium cooled fast reactor SNR-300 are reported. Vibration measurements were carried out in a sodium component test facility of 50MW. It was shown that no vibration difficulties would arise in the steam generators.

42784 (IWGFR—18, pp 58-62) **Commission of the European Communities - Activities in the field of fast reactors.** Balz, W. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

The Commission of the European Communities is performing activities in the field of fast reactor on two lines: a) activities aiming to prepare the commercialization of fast reactors by coordination and collaboration between national programmes. b) the execution of an own programme in the Joint Research Centre at Ispra (Italy) and

Karlsruhe (Federal Republic of Germany) in the field of FBR safety and research on Pu-bearing fuel.

42785 (IWGFR—18, pp 50-58) **Present state of development of the fast breeder project in the Federal Republic of Germany, Belgium and the Netherlands, and progress achieved during 1976 and early 1977.** Daeunert, U.; Kessler, G. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

Development of the LMFBR continues to be a major long-term objective of the nuclear programme of the DEBENE+ countries. The following milestones of the German-Belgian-Dutch LMFBR programme are reported: status of work on KNK-II; status of construction work on SNR-300; participation of DEBENE utilities in the SUPERPHENIX project and project work on SNR-2; Franco-German cooperation in the field of LMFBR.

42786 (IWGFR—18, pp 1-4) **Status of the USSR fast reactor programme as of March 1977.** Krasnojarov, N.V.; Inyutin, E.I. Jun 1977. (In Russian).

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

Results of experimental and applied research performance of BR-10, BOR-60 and BN-350, construction of BN-600 reactor and initial design of BN-1600 reactor are reviewed.

42787 (IWGFR—18, pp 45-50) **Review of fast reactor activities in Italy, April 1977.** Pierantoni, F. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

In the frame of the cooperation with France, a short outline of the main results, as well as the status of the research and development work in Italy is given.

42788 (IWGFR—18, pp 12-35) **Review of the UK fast reactor programme. March 1977.** Smith, R.D. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

This paper reports on the Fast Reactor Programme of United Kingdom. These are the main lines: Dounreay Fast Reactor; Prototype Fast Reactor; Commercial Fast Reactor; engineering development; materials development; chemical engineering/sodium technology; fast reactor fuel; fuel cycle; safety; reactor performance study.

42789 (IWGFR—18, pp 8-11) **Review of fast reactor progress in Japan.** Tomabechi, K. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

Only highlights and some topics are reported: Using the Fast Critical Assembly (FCA), experiments to evaluate fission rate in the fuel storage position within the "MONJU" vessel were performed; detectors of hydrogen in the sodium of the steam generator were developed; experiments to stimulate large sodium water reactions which might take place in a steam generator have been carried out; experiments concerning local fuel failure and tests on various components to be used for "MONJU" have been continued; concerning safety, experiments of sodium burning were performed.

42790 (IWGFR—18, pp 35-45) **Development of French programme on fast reactors, from March 1976 to March 1977.** Vautrey, L. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

The following milestones of the French LMFBR programme are reported: RAPSODIE (irradiation experiments in order to study the behaviour of the different fuel components of a sodium cooled fast reactor); PHENIX (the burn-up of the first core has reached the nominal value of 50,000MWD/T); SUPER-PHENIX (status of construction).

42791 (IWGFR—18, pp 4-8) **U.S. LMFBR programme as of 4-1-77.** Yevick, J. Jun 1977.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

In Tenth annual meeting, Vienna, Austria, 29 March - 1 April 1977. Summary report. Part II.

This summary covers the status of LMFBR projects and base programme activities: Experimental Breeder Reactor-II; the Fast Flux Test Facilities; the Clinch River Breeder Reactor Plant; the High Performance Fuel Laboratory; the Hot Pilot Plant.

42792 (IWGFR—18) **Tenth annual meeting.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). May 1976. 5p. (In Russian). (CONF-770398—). Dep. NTIS (US Sales Only), PC A04/MF A01.

From 10. IAEA working group on fast reactors; Vienna, Austria (29 Mar 1977).

Each paper has been separatey processed for the Energy Data Base. (DG)

42793 (NEDM—14137) **Small leak scoping tests: secondary tube failure test; sodium/water reaction flame photography.** Gudahl, J.A.; Hunsicker, J.C.; Ulpindo, C.Q. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Aug 1976. Contract EY-76-C-0893-010. 36p. AT.

Two Sodium/Water Reaction Scoping Tests are described. In the first test, a 19 tube bundle of 2¼ Cr-1 Mo material was assembled in a 1.22 inch (3.1 cm) triangular array, simulating the Clinch River Breeder Reactor Plant steam generator. The assembled test section was placed in a liquid sodium test vessel and a steam jet was directed through the liquid sodium to a target tube. The initial injection of water was directed through the space between two tubes to impinge on a tube 1.5 inches (3.8 cm) from the injection orifice. This target tube was pressurized with steam. The impinging jet penetrated the 0.109 inch (.8 cm) target tube after 20 minutes. Steam from the target tube then impinged onto one of the adjacent tubes causing it to fail after a further 63 seconds. The test and test results are described. The second group of tests was conducted to obtain photographs of a liquid sodium/water reaction. Combustion occurred in all six tests and in most cases, visual documentation, color still and cinema photography, showed that a flame or flame pattern was produced.

42794 (WARD-I—10134-2) **Post test examination of double-wall tube for interface wear and water side corrosion effects in a liquid metal heated steam generator.** Padden, T.R.; Schmidt, D.K. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1977. Contract EY-76-C-03-0962. 162p. AT.

Post test evaluation of a double-wall steam generator tube of a liquid metal heated 2¼ Cr-1 Mo, single tube, J-modular evaporator was performed following a multi-phase test program to determine water side corrosion effects, tube-to-tube interface effects and weld performance. Exposure of the steam generator tubing to 8494 hours of "worst case" water chemistry conditions of 30 ppb sodium under evaporator tube wall "dry out" conditions at 240,000 Btu/hr-ft² heat flux produced no deleterious effects. A conditional maximum corrosion rate of 0.90 mils/year was calculated at the dry-out zone on the basis of corrosion oxide thickness measurements. Tube-to-tube interface wear did occur with a maximum wear depth of 7.9 mils. Tube-to-tubesheet welds and dissimilar metal welds were adequate with no signs of deterioration resulting from the test.

42795 Analysis of the central blockage wake in an LMFBR-subassembly. Arai, M.; Hirata, N. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan). Research and Development Center). *Nucl. Eng. Des.;* **45**: No. 1, 127-132(Jan 1978).

A simple model is presented to estimate the wake size and the average velocity of the circulating flow downstream of a central blockage in a subassembly. A computer code, newly developed for the purpose was used to examine the model results. It is shown that both the model results and the code closely fit experimental results. It is seen that the size of a turbulent wake is nearly independent of inlet coolant velocity, whereas the velocity of the circulating flow in the wake is nearly proportional to the inlet velocity. Both the length of the wake and the velocity in it increase as the blockage increases. The maximum temperature is reached with a blockage of more than 0.6 of the subassembly cross section, and varies inversely with inlet velocity.

42796 Simple forced diversion model for study of thermal-hydraulic transients in LMFBR subassembly. Chen, W.L.; Grolmes, M.A.; Ishii, M. (Argonne National Lab., Ill. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 53-66(Jan 1978).

The generalized simple, transient, integral energy balances based on the average properties for the fuel and cladding have been used in a new multichannel thermal-hydraulic model for calculating the transient behavior of coolant in the rod bundle. This model was developed to provide a simple useful tool for analyzing the flow and thermal transients in a rod bundle with reasonable accuracy, and to understand the fundamental characteristics of flow in the rod bundle under both normal and abnormal condition of reactor-core operation.

42797 Dynamic instabilities in tubes of a large capacity, straight-tube, once-through sodium heated steam generator. Unal, H.C.; Gasselt, M.L.G.van (Nijverheidsorganisatie TNO, Apeldoorn-Zuid (Netherlands). Centraal Technisch Instituut TNO); Ludwig, P.W.P.H. (Neratoom N.V., The Hague (Netherlands)). *Int. J. Heat Mass Transfer;* **20**: No. 12, 1389-1399(Dec 1977).

Density-wave type dynamic instabilities were detected in the tubes of a large-capacity sodium heated steam generator. The peak-to-peak amplitudes of these oscillations varied between 9 to 60 K and the periods between 4 and 7.6s. Experimental data for the periods and the inception conditions of the dynamic instabilities, and the data found in literature obtained for a tube and a rectangular channel across which pressure drop is constant, have been correlated with simple equations for the following range of conditions: pressure: 4.1 to 17 MN/m^2; exit quality: 0.27 to 1.59; inlet subcooling: 3 to 111 K; ratio of heated length to hydraulic diameter: 153 to 1921; hydraulic diameter: 0.0045 to 0.0126 m; enthalpy rise in the channel: 582 to 2130 kJ/kg; mass velocity: 353 to 2088 kg/m^2s; average heat flux 0.1 to 3.25 MW/m^2; period: 0.35 to 7.6s. At the start of dynamic instabilities the steam quality (or the enthalpy of the steam or steam/water mixture) at the outlet of the boiling channel is constant for a given subcooling, pressure and geometry in the low subcooling range, and for a given pressure and geometry for the range of medium and high subcoolings. The period of the dynamic instabilities is a function of the transit time of a fluid particle in the boiling region of a channel, the Froude number, and the ratio of the length of the boiling region to the total heated length. A hot channel factor has also been established which relates the operating conditions in the tube in which the dynamic instabilities occur first, to the average operating conditions in the steam generator.

42798 Thermal insulation. Durston, J.G.; Birch, W.; Facer, R.I.; Stuart, R.A. (to Nuclear Power Group Ltd., Risley (UK)). British Patent 1,491,204/A/. 9 Nov 1977. 6p.

Reference is made to liquid metal cooled nuclear reactors. In the arrangement described the reactor vessel is clad with thermal insulation comprising a layer of insulating blocks spaced from the wall and from each other; each block is rigidly secured to the wall, and the interspaces are substantially closed against convectional flow of liquid by resilient closure members. A membrane covering is provided for the layer of blocks, with venting means to allow liquid from the reactor vessel to penetrate between the covering and the layer of blocks. The membrane covering may comprise a stainless steel sheet ribbed in orthogonal pattern to give flexibility for the accommodation of thermal strain. The insulating blocks may be comprised of stainless steel or cellular or porous material and may be hollow shells containing ceramic material or gas fillings.

42799 Experimental investigation of the formation of critical boiling nuclei in superheated sodium. Riethmueller, R. (Karlsruhe Univ. (TH) (Germany, F.R.). Inst. fuer Reaktortechnik). *Nucl. Eng. Des.;* **43**: No. 2, 295-309(Sep 1977).

This work deals with the problem of boiling nuclei growth up to the critical size in superheated sodium. The sodium was superheated to a certain degree without initiating the onset of boiling. The lifetime of the superheated state - defined as the waiting time - was measured. The experiments were performed with stagnant sodium in a gas-free apparatus. The sodium temperature and superheat were up to 960°C and 360°C, respectively. Waiting times of up to some hours were measured with large scattering of values. Cold trap purifications influenced the waiting time irreversibly. Natural boiling nuclei were unstable. An artificial boiling nucleus (small cylindrical cavity) was inactive. The existence of many cavities in the test chamber surface was demonstrated by a scanning electron microscope. Experimental results are compared with theoretical predictions from known nucleation models. The dynamic model of the formation of collective heterogeneous boiling nuclei agreed qualitatively.

42800 Damping of the transverse impulsive motion of a Timoshenko beam resting on a thin fluid layer. Zehlein, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 373-379(Sep 1977).

A discrete model for the one-dimensional incompressible transient axial squeeze potential flow within the thin fluid layer between two adjacent LMFBR sub-assemblies caused by the impulsive transverse bending of these beam-type core components is described. The numerical schemes used to determine the time- and space-dependent velocity and pressure fields are outlined. Emphasis is placed on the combined Lagrangian particle/Euler cell approach newly proposed here. In particular two different notions of Lagrangian particles, the convected Lagrangian particle (CLP) and the displaced Lagrangian particle (DLP) are introduced and evaluated. Some remarks on the coupling technique for the fluid-structure interaction are also given. Preliminary results recommend the DLP because of its higher computational efficiency.

42801 Technologies and materials of FBR 'Joyo', all domestically provided. Uematsu, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Kodama, T. *Kogyo Rea Metaru;* No. 63, 34-39(Jul 1977). (In Japanese).

The fast breeder experimental reactor "Joyo" attained the criticality on April 24,1977, and the authors took this occasion to review the using conditions and the qualities of materials of main components. The features of fast breeder reactors are liquid sodium cooling, high specific power output, high irradiation dose with fast neutrons and high coolant temperature. The materials for Joyo were selected, taking these points in consideration. The basic policy of constructing Joyo is the independent development by domestic technologies, therefore imports were not used at all. The main components of Joyo are reactor vessel, fuel assemblies, primary cooling system, secondary cooling system, and containment vessel. The materials and their using conditions of these components are outlined. Austenitic stainless steels SUS 304 and 316 are mostly used, and this tendency seems to be inherited to the prototype reactor "Monju" constructed hereafter. However, in Monju, the burn-up for fuel pins, coolant temperature, and neutron irradiation dose are high as compared with those of Joyo, therefore the void swelling due to irradiation must be reduced by increasing cold-working rate, and high temperature strength must be improved by the addition of boron and phosphorus, regarding cladding tubes. Steam generator is not installed in case of Joyo.

42802 Development of fast reactors and studies on materials. Mishima, Y. (Tokyo Univ. (Japan). Faculty of Engineering). *Kinzoku;* **47**: No. 6, 7-12(Jun 1977). (In Japanese).

The effort of independent development has born fruit, and the fast experimental reactor "Joyo" has attained the criticality on April 24, 1977. The fast neutron source reactor in the University of Tokyo has been in operation since 1972, but Joyo is the first full-scale fast reactor. The refining techniques for sodium and the purity control for sodium in use were important problems. The cooling of fuel rods, the swelling of fuel due to high burn-up, the strict dimensional allowance for fuel assemblies owing to poor controllability, the supporting method without large flow resistance for fuel assemblies, the local overheat of claddings due to FP gas leak, and the irradiation damage of claddings were deemed to be the requirements. The method of manufacturing fuel pellets was investigated. The temperature of coolant has been set at 500 deg. C reluctantly because of the difficulties in the development of cladding material. Steam-cooled fast reactors were conceived to avoid delay, but were not materialized. The cladding material for Joyo is 316 stainless steel containing reduced nitrogen as the measures to helium damage. As the piping material, 2,1/4 Cr-1Mo steel without niobium was used. In Japan, nickelclad vanadium alloy has been investigated in the University of Tokyo to give sodium resistance with nickel cladding.

42803 Fast breeder reactor. Ziegler, A. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 1,948,912/C/. 5 May 1977. 6p. (In German).

The invention deals with a fast breeder reactor with liquid metal cooling and with fuel zone co-axially surrounded by a breeder zone without a separating wall, where the coolant is admitted to the whole cross-section of the breeder reactor with the same pressure. It is difficult in such nuclear reactors to maintain a constant pressure uniformly over the entire reactor cross-section. According to the invention, this is achieved in that one arranges the fuel elements as well as the breeder elements in open construction and designs flow-conducting devices arranged on top of one another which influence the coolant flow. The design of this flow-conducting device is part of the patent claims.

42804 Physics and engineering characteristics of a LMFBR in long-term operation. Kujal, J.; Jakab, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). *Jad. Energ.;* **23**: No. 5, 162-168(May 1977). (In Czech).

The results are presented of calculating the main physics and engineering parameters of a 1600 MWe fast breeder reactor. The changes in the parameters during long-term operation at a selected realistic fuel cycle are studied. Homogeneous isotope concentrations in the FBR reactor core and breeding blankets in the initial state, and homogeneous concentrations of heavy fuel isotopes in all reactor regions before and after the 6th refuelling are tabulated. The mean burnup of fuel removed from the core under steady state conditions is 60 MWd/kg U+Pu, 3.5 MWd/kg U+Pu for the front breeding blanket and 5.6 MWd/kg U+Pu for the side breeding blanket. The course of breeding ratio is graphically shown for the entire reactor and partial breeding ratios are listed for the core, front and side breeding blankets. Changes were studied in the power distribution along the reactor radius and its levelling up during long-term operation is shown. The mathematical model of the reactor is briefly described as are the basic calculation procedures. Actual operating conditions of the reactor are considered, such as fractional discontinuous refuelling and reactor operation at a given output with ksub(eff)=1.

42805 Approach to selected structural mechanics problems of the fast power reactor core. Dienstbier, J.; Pazdera, F. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). *Jad. Energ.;* **23**: No. 4, 140-146(Apr 1977). (In Czech).

Thermal deformations, swelling and thermal creep result in dimensional changes and deformations of fuel assemblies in the core and the side breeding blanket. The method of calculating bending deformations of the fuel assemblies is based on the theory of slim statically indefinite beams calculated using the matrix technique. The beam is divided into elements and linear temperature distribution and neutron flux distribution along the element length are assumed. The calculation method was used in compiling programme PA 2147 in the GIER ALGOL language, simulating straining and deformations of the individual assemblies during reactor operation. The programme also covers the calculation of assembly cross section increase due to thermal dilatation, swelling and to elastic creep deformation by sodium overpressure in the assembly. The results are briefly described of the behaviour of the BN-600 fast reactor assemblies and of the strength deformation calculations of assemblies of a 1600 MWe fast power reactor. A toroidal model is shown for the description of strength and deformation conditions in the spacing level of fast reactor assemblies. The model was used in writing programme PA 2132 in the GIER ALGOL language. The results show that stress and deformation conditions in the fast sodium cooled power reactor core approach limit conditions, which is mainly due to the swelling of structural material, i.e., austenitic steel.

42806 Research and development on steam generator for fast breeder reactor. Tanaka, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). *Karyoku Genshiryoku Hatsuden;* **28**: No. 4, 321-335(Apr 1977). (In Japanese).

The sodium-heated steam generator for a liquid metal fast breeder reactor is one of the most important components, but many problems exist, such as the possibility of sodium-water reaction in the steam generator, the heat transfer characteristics of sodium, the flow instability of water inside heat transfer tubes, the choice of material, etc. Much activity is concentrated for the research and development of the steam generator for "Monju" plant which is the first prototype fast breeder, electricity-generating plant in Japan. The basic flow chart, the layout of the plant, the key parameters of the steam generator for "Monju" plant are explained. For steam generators, many concepts for heat transfer tubes have been devised, for example helical coil tube, straight tube, U tube, hair pin tube, etc., and each type has advantages and also disadvantages. The research and development works for the steam generator are reviewed in general, and 50 MW steam generator test and many sodium-water reaction tests are described in detail, which have been carried out at Oarai Engineering Center of the Power Reactor and Nuclear Fuel Development Corporation.

42807 Wastage phenomena due to small leak sodium-water reaction. Reaction temperature and wastage pattern. Nei, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)); Hori, M. *Nippon Kikai Gakkai Rombunshu;* **43**: No. 368, 1418-1425(Apr 1977). (In Japanese).

A theory was developed for analyzing the wastage phenomena due to the sodium-water reaction. The theory is based on the viewpoint that the wastage is primarily due to corrosion. Equations for temperature and concentration distributions of reaction product jet were derived the first place and secondly, an equation for the temperature dependence of corrosion was derived. The results of theoretical analysis based on these equations were compared with the results of wastage experiments performed by the present authors and that performed at APDA (Atomic Power Development Associates). The results of authors' experiments are described together with the experimental conditions and used apparatus. Nozzle diameter, sodium-water temperature, and the water pressure were varied as parameters. As for theoretical analysis, descriptions are given of the analytical model, basic equations for jet flow accompanying chemical reactions, the shape of surface reaction, and the temperature distribution of jet flow. Finally, the mechanism of wastage is considered and discussed based on the theoretical analysis and comparison with the results of experiments.

42808 Availability analysis of commercial fast breeder reactor's steam generator system. Maekawa, I.; Shindo, Y.; Sakano, K. (Kawasaki Heavy Industries Ltd., Kobe (Japan)). *FAPIG (Tokyo);* No. 84, 8-12(Feb 1977). (In Japanese).

Optimization study for the availability and load factor of the sodium heated steam generator for a commercial fast breeder reactor was conducted as one of the economical feasibility study. Three cases were chosen for this availability analysis. The numbers of evaporator, super-heater and reheater are one each in case A, 4, 2 and 2 respectively in case B, and 5, 4 and 4 respectively in case C, and this plant has 1500 MWe capacity and four loops. The analysis was conducted by fixing the range of analysis, and then the factors of plant outage especially for the probability of faults and maintenance time, and each fault mode was represented by the fault tree. The unavailability per each loop, the system unavailability and the load factor in cases A, B and C are shown, and the analytical results show that the load factor is the best in case B in this analysis. It is necessary to research the probability of faults in steam generator to accumulate the field data, and to investigate the system and the operational method to lessen low availability machinery to increase their availability.

42809 BN-350 reactor shielding studies. Bakumenko, O.D.; Zvonarev, A.V.; Kulakovsky, M.J.; Koleganov, J.F.; Pomerantsev, G.V.; Sergeev, V.A.; Tverdovsky, N.D.; Savitsky, V.I.; Tsurukin, J.P.; Usanov, V.I. *Atomkernenergie;* **30**: No. 4, 305-307(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

This paper presents the result from experimental and calculational studies carried out at the BN-350 reactor start-up with the aim of determining the efficiency of intra-vessel and biological shielding of the reactor: distributions of reaction rates for various indicators in the upper reactor shield, specific activity values for reactor coolant and gas system, radiation situation within primary circuit cells and in the rooms adjacent to the reactor. The experimental data obtained are compared with the calculated ones.

42810 Irradiation effects and design of LMFBR permanent reactor structures. Blackburn, L.D.; Knecht, R.L. (Westinghouse Hanford Co., Richland, Wash. (USA)). *Atomkernenergie;* **30**: No. 4, 278-281(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

Current approaches to the design of permanent reactor structures for LMFBRs emphasize the restriction of neutron radiation exposure to levels which do not grossly alter the mechanical behavior of the materials of construction. Conventional quantitative design procedures can then be employed to limit calculated stresses to acceptable values. The decrease in material ductility with irradiation has generally been used as a criterion for limiting neutron exposure, and experimental results are examined in the light of establishing such limits. When radiation exposure must exceed the established limits, the properties of irradiated material must be used to modify design allowable stress intensity values and creep-fatigue interaction. Fracture mechanics analyses are also a potentially important feature of the design procedure in this regime. Irradiation-induced swelling and creep effects also should be accounted for in the design. Several examples of relevant property changes are reviewed.

42811 Radiation protection/shield design. A need for a systems approach. Disney, R.K. (Westinghouse Electric Corp., Madison, Pa. (USA)). *Atomkernenergie;* **30**: No. 4, 256-260(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

Radiation protection/shielding design of a nuclear facility requires a coordinated effort of many engineering disciplines to meet the requirements imposed by regulations. In the following discussion, the system approach to Clinch River Breeder Reactor Plant (CRBRP) radiation protection will be described, and the program developed to implement this approach will be defined. In addition, the principal shielding design problems of LMFBR nuclear reactor systems will be discussed in realtion to LWR nuclear reactor system shielding designs. The methodology used to analyze these problems in the U.S. LMFBR program, the resultant design solutions, and the experimental verification of these designs and/or methods will be discussed.

42812 Investigation of heat transfer when cooling a turbulent flow of chemically reacting N_2O_4 in a tube at elevated temperatures of a channel wall. Devoino, A.N.; Stepanenko, V.N.; Tverkovkin, B.E.; Kazazyan, N.A. (AN Belorusskoi SSR, Minsk. Inst. Yadernoi Ehnergetiki). *Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk;* No. 1, 60-64(1976). (In Russian).

The results are given of processing of data on heat exchange when cooling the chemically reacting N_2O_4 dissociating coolant gases. The pressure was $8x10^5$ to $61x10^5$ N/m², temperature of stream 410-830°K, channel wall tube temperature 400-670°K, heat flow $2.3X10^4$-$2.6X10^5$W/m², and Reynolds no. $3.1x10^4$-$4.5x10^5$, which corresponds to a flow rate of 3.5-4.5m/sec. The maximum spread in the majority of the experimental data was $< +$-20%; the average was +12 to -14%.

42813 Method of bonding a spacer pad. Nakayasu, F. (to Nuclear Fuel Industries Ltd., Tokyo (Japan)). Japanese Patent 1977-67485/A/. 1 Dec 1975. 3p. (In Japanese).

A method of bonding a spacer pad, permitting a predetermined size to be readily obtained while increasing the mechanical strength in the radial direction and preventing thermal deformation of the shroud itself is described. Each spacer pad consisting of a hard facing material of predetermined shape and dimensions is formed in its central portion with a through-hole, and then its edge portion is welded to a shroud by TIC welding. Subsequently, the through-hole

is buried by fusing the hard facing material to thereby obtain bonding of the pad to the base.

42814 Cover gas system in a reactor. Iwasaki, T.; Koike, H.; Kawashima, H.; Uemura, A. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-60399/A/. 14 Nov 1975. 5p. (In Japanese).

A tank for temporarily store surplus gases resulting from a pressure differential of cover gases required at the time of power operation and at the time of replacing fuel as the gases processed in a distilling column device for recovering radioactive rare gases is described. A cover gas space in a reactor vessel is connected to a first tank provided with a pressure gage. The cover gas within the first tank is sucked and compressed by a compressor to be stored in a second tank, and then passing through the rare gas removing and recovering device into a cover gas header and thence returned to the aforesaid cover gas space. On the other hand, a third tank is connected to the first tank, said third tank being connected to said cover gas header. Also, a cover gas feeding device is connected to the third tank. In this system, extra gases are stored in the third tank.

42815 Defectiveness detector. Michiguchi, Y.; Suzuki, K.; Takahashi, F. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57498/A/. 7 Nov 1975. 4p. (In Japanese).

A method to permit three-dimensional determination of the position of abnormal sound generation and also permit early and reliable detection of the defectiveness of an apparatus is described. A plurality of wave guides providing different speeds of sound propagation are provided on a plurality of points in a machine at which the defectiveness is to be detected, and each of them is connected to a sound detector. The defectiveness is detected by determining a point of generation of defectiveness from the time difference in the detection of a defective sound signal in each detector.

42816 Strainer device. Mokuya, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57499/A/. 7 Nov 1975. 4p. (In Japanese).

A method to provide a strainer device, which is adapted to facilitate flushing and is particularly suited for installation in the cooling system of a liquid metal cooled fast breeding reactor is described. A casing accommodating a strainer and a blind plate for the selection of a flow path is provided at a suitable portion of the duct line. The blind plate is adapted to be rotated by an opening and closing means consisting of a rod. bellows, shaft and so forth. At the time of flushing, the duct line is sealed by the blind plate.

42817 Dual construction device having a mechanism for detecting leakage of sodium. Kimura, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-52092/A/. 24 Oct 1975. 3p. (In Japanese).

A method to provide a device, of which outer wall is composed of a transparent material, interiorly provided with a sodium emitting heater and exteriorly provided with a phototube, so as to early discover a leakage of liquid sodium is described. When the liquid sodium in the inner wall is leaked into the outer wall through a crack, a fluorescence is generated by heat from a heater, and the generated fluorescence is detected by means of a phototube to actuate an alarm.

42818 Device for starting a steam generator by heating sodium in a reactor. Nakano, H. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-48797/A/. 16 Oct 1975. 5p. (In Japanese).

A method to enhance cooperation between ventilation and steam conditions of turbine and ventilation condition relative to a superheater at the time of starting a plant using a fast breeder, and to enhance safety with respect to failure of heat transmission tubes at the time of start is described. In a device in which steam generated in an evaporator is fed to a high pressure turbine through a superheater and an outlet steam of high pressure turbine is reheated by means of a re-heater and fed into a turbine on the side of low pressure to drive the turbine for power generation, opening and closing valves are mounted on outlet and inlet pipes, respectively, of the heat transmission pipe in the super heater, said outlet and inlet pipes being connected by a bypass pipe. Upstream side of the opening and closing valve on the inlet pipe and the downstream side of the opening and closing valve on the outlet pipe and connected by a bypass pipe in the re-heater and said bypass pipe in the re-heater is provided with a steam heat exchanger to be heated by steam in the outlet of the superheater, and a steam line in an auxiliary boiler is connected to the side of re-heater from the opening and closing valve on the heat transmission pipe in the re-heater.

42819 Container for a liquid metal cooled reactor. Naito, K.; Fukushima, Y. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-43097/A/. 3 Oct 1975. 4p. (In Japanese).

A method is described to prevent combustion of leaked liquid metal by sealing the upper portion of a liquid metal pool which is disposed within a liquid metal duct chamber or the like, the liquid metal drain tube being inserted in the chamber, and the inside of the pool being filled with inert gas while disposing a liquid metal cover member. Structure: Sodium leaking into a primary cooling system duct chamber flows, as it fuses the plug, through a drain duct into a sodium pool section which is sealed with a lid. At this time, sodium causes inert gas filled there to flow out through a gas purge duct, thus causing a sodium cover member to float up and cover the top surface of the incoming sodium.

42820 Reactor. Miyazawa, T. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-41795/A/. 29 Sep 1975. 6p. (In Japanese).

A method to permit failure detection for the reactor fuel through detection of the nuclear fission product in the gaseous phase or solid phase introduced into liquid metal coolant passing through the reactor body is described. Part of the liquid metal coolant passing through the reactor body is led through the sampling system to the outside of the reactor body and is returned through a tank to the reactor body. A neutron detector having a γ-ray shield function is disposed in the neighborhood of the afore-mentioned tank, whereby delayed neutrons emitted by the nuclear fission product contained in the coolant within the tank are decelerated into thermal neutrons for detection. In addition, gas present in the upper part of the tank is led to a nuclear fission product gas detector provided in the tank for detecting the nuclear fission product gas contained in the gas led to the detector. The operation of the reactor body is controlled in accordance with the output signals from the afore-mentioned detectors.

42821 Liquid metal cooled fast breeder. Nakai, Y.; Yamagishi, Y.; Koga, T. (to Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Japanese Patent 1977-40296/A/. 26 Sep 1975. 3p. (In Japanese).

A method to increase the operation efficiency of the reactor by making optimum the flow distribution of coolant within a reactor container is described. In a fast breeder having a high pressure plenum communicating with the core fuel, a low pressure plenum communicating with the blanket fuel and a lower plenum communicating with the high pressure plenum, the low pressure plenum and lower plenum are connected together via a duct, and a flow control device is provided on the duct for controlling the flow of liquid metal flowing through the core fuel and blanket fuel. The flow control device comprises an electromagnetic pump, a flow control valve, and electromagnetic flow gauge and a pressure gauge. When the flow rate required for the low pressure plenum is lower than a preset flow rate, the electromagnetic pump is operated to return the undesired quantity of coolant from the low pressure plenum to the lower plenum, thus reducing the flow in the low pressure plenum.

42822 Fuel rod for nuclear reactor. Takeda, S.; Maki, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-31294/F/. 3 Sep 1975. 2p. (In Japanese).

A method to improve the gap conductance by reducing the gap between cladding tube and fuel pellets by disposing a shock absorber in the gap, thereby protecting the cladding tube is described. A structure of a soft material such as copper and silver is disposed in the gap between fuel pellets constituting a nuclear reactor fuel assembly and cladding tube, thereby reducing the gap and thus improving the gap conductance. The stress produced at the fuel pellets tend to outwardly push and broaden the cladding tube is alleviated as the afore-said structure acts as a shock absorber. In this way, it is possible to prevent failure to the cladding tube.

42823 Liquid metal cooled fast breeder reactor. Nakai, Y.; Yamagishi, Y.; Koga, T. (to Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Japanese Patent 1977-25997/A/. 25 Aug 1975. 3p. (In Japanese).

A method to permit readily making optimum the distribution ratio between the low and high pressure plenum flows of the coolant by the provision of a low pressure lead-in chamber having a jet pump below the low pressure plenum is described. In a liquid metal cooled fast breeder, a high pressure plenum communicating with the core fuel and a low pressure plenum communicating with blanket core fuel are communicated with a lower plenum having a liquid metal inlet. A low pressure lead-in chamber having a lower opening and provided with a jet pump is formed below the low pressure plenum and is provided with a flow control device. Further, a duct open to the lower plenum is connected to the nozzle of the jet pump.

42824 Method of removing oxygen from molten metals in nuclear technology. Jakes, D. Czech Patent 158,060/B/. 15 May 1975. 2p. (In Czech).

The method is claimed of the electrolytic removal of oxygen from molten metals in nuclear technology, in which ionized oxygen atoms are converted by a system blocking the electron beam. This blocking system consists of one or more alkaline earth metal oxides and of a solid electrolyte. The formed gas molecules are removed by a stream of inert or reduction gas characteristic by the fact that the ionized oxygen atoms are converted by a system blocking the

electron beam at a potential stability of maximally 10 mV/min, or to advantage at a stability of maximally 5 mV/min. At this stability value considerably less damage occurs to the electrolytic tube as a result of corrosion and solid electrolyte life is considerably longer.

REGULATION AND LICENSING

42825 (DOE/ET—0030/1(78)) **U.S. Central Station Nuclear Electric Generating Units: significant milestones (Status as of January 1, 1978).** (Department of Energy, Washington, D.C. (USA). Div. of Nuclear Power Development). Mar 1978. 29p. Dep. NTIS, PC A03/MF A01.

Tabulated data on the significant licensing, construction, and operating history dates for nuclear power plants in the U.S. are presented.

42826 (EMD—78-29) **Nuclear powerplant licensing: need for additional improvements.** Staats, E.B. (General Accounting Office, Washington, D.C. (USA)). 27 Apr 1978. 88p. General Accounting Office, Washington, DC.

Report to Congress by the Comptroller General of the United States.

In this report GAO reviews the Nuclear Regulatory Commission's management process for evaluating nuclear powerplant designs and sites and makes recommendations for improvements. The report also discusses the Commission staff's perspective on the adequacy of the licensing process, Commission staff's ability to raise dissenting technical opinions without experiencing adverse personnel actions, and administration's proposed legislation to streamline the licensing process.

42827 (NUREG—0425) **NRC inspection alternatives. A study report.** Conver, S.K.; Legasey, E.E.; LeDoux, J.C.; Rehfuss, C. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Inspection and Enforcement). Apr 1977. 59p. NTIS $5.25.

IE's efforts in pursuing various resident inspection concepts are consistent with the stated interests of the new Administration in improving federal oversight of the nuclear industry. Four alternative resident inspection concepts are described and evaluated vis-a-vis the current program. The concept of full-time onsite inspectors as a preferred alternative is discussed. The tasks necessary to implement this preferred alternative are described.

42828 (NUREG/CR—0043) **Assessment of current NRC/IE professional training program and recommendations for improvement.** Bartley, H.J.; Hagerup, J.E.; Harrison, O.J.; Heyer, F.H.K.; Kaas, I.W.; Schwartz, E.G. (General Research Corp., McLean, Va. (USA)). May 1978. 43p. NTIS $4.50.

This document is the General Research Corporation (GRC) report on Task III: to assess the current NRC/IE professional training program and to provide recommendations for improvement. The major objectives of this task were to determine the overall effectiveness of the NRC/IE training program and to provide recommendations for improvements where appropriate. The research involved a review of course manuals and of student critiques, observation in the classroom and person to person interviews; it also included an evaluation of the assignment of instructors to the Career Management Branch. Findings addressed refresher training, retread training and initial training—with emphasis on the last of these. Conclusions are that: (1) The curriculum provides, in general, types and levels of training needed; (2) the mix of training methods used is correct; and (3) the training management is effective. However, the training facilities do not reflect a commitment to quality instruction nor is assignment as instructor to the Career Management Branch attractive to inspectors. Recommendations presented in the report are based upon the findings; all lie within the implementing authority of Headquarters NRC/IE.

42829 (PB—273302) **NRC testimony before the Subcommittee on Nuclear Regulation of the Committee on Environment and Public Works, United States Senate.** (Nuclear Regulatory Commission, Washington, D.C. (USA)). Oct 1977. 47p. (NUREG—0370). NTIS PC A03/MF A01.

NRC staff testimony before the U.S. Senate's Subcommittee on Nuclear Regulation, Committee on Environment and Public, is presented. The testimony pertains to the staff's role in the licensing process affecting the Virginia Electric and Power Company's North Anna nuclear plant. It explains the steps taken since 1973, and particularly since formation of the U.S. Nuclear Regulatory Commission in January 1975, to improve the timeliness of submission of information from the staff to the Commission licensing boards.

42830 (PB—273770) **Owners of nuclear power plants.** Wood, R.S.; Kominars, K. (Nuclear Regulatory Commission, Washington, D.C. (USA)). Oct 1977. 53p. (NUREG—0327). NTIS PC A04/MF A01.

The listing indicates percentage ownership of commercial nuclear power plants by utility companies as of August 15, 1977. The list includes all plants operating, under construction, docketed for NRC safety and environmental reviews, or under NRC antitrust review. It does not include those plants announced but not yet under review or those plants formally cancelled. In many cases, ownership may be in the process of changing as a result of antitrust license conditions and hearings, altered financial conditions, changed power needs, and other reasons. However, this list reflects only those ownership percentages of which the NRC has been formally notified. Part I lists plants alphabetically with their associated applicants and percentage ownership. Part II lists applicants alphabetically with their associated plants and percentage ownership. Part I also indicates which plants have received operating licenses (OL's).

42831 (PB—275229) **Procedures, source term measurement program. Topical report.** Dyer, N.C.; Nieschmidt, E.B.; Keller, J.H.; Motes, B.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1977. 77p. NTIS PC A05/MF A01.

An in-plant source term measurement study is being conducted for the U.S. Nuclear Regulatory Commission at operating light water nuclear power plants. The purpose of the study is to provide the NRC with a data base for use in the licensing process of pressurized water reactor power plants. This report presents the sample collection and analysis techniques used in the in-plant source term measurement program.

42832 (RDT-E—6-19T(3-78)) **Radial reflector assembly for liquid metal fast breeder reactors.** (Department of Energy, Washington, D.C. (USA). Div. of Nuclear Power Development). Mar 1978. Contract EY-76-C-14-2170. 13p. RSO.

This standard sets forth the requirements for the fabrication, inspection, and quality assurance of core radial reflector assemblies for use in liquid metal fast breeder reactors.

42833 (RDT-F—6-5T(2-78)) **Welding and brazing qualifications (supplement to ASME boiler and pressure vessel code, section IX).** (Department of Energy, Washington, D.C. (USA). Div. of Nuclear Power Development). Feb 1978. Contract W-7405-ENG-26. 58p. RSO.

Included are specifications of general requirements, procedure qualifications, performance qualifications, and data for welding and brazing; requirements for tube-to-tubesheet welds, requirements for seal welds, requirements for hard surfacing, and methods and requirements for tests. (DG)

42834 (RDT-E—2NB-T(Rev.)(3-78)) **Class 1 nuclear components (supplement to ASME boiler and pressure vessel code, section 111, subsections NCA and NB).** (Department of Energy, Washington, D.C. (USA). Div. of Nuclear Power Development). Mar 1978. Contract W-7405-ENG-26. 37p. RSO.

Supplementary rules are specified for the construction of nuclear power plant components. Included are general requirements, material specifications, design specifications, fabrication and installation requirements, and testing procedures and standards. (DG)

42835 **Are LMFBR permits unconstitutional.** Wagner, H.; Ziegler, E. *Atomwirtsch., Atomtech.;* **22**: No. 12, 622-627(Dec 1977). (In German).

The August 18, 1977 decision by the Muenster Higher Administrative Court to have the Federal Constitutional Court investigate the constitutionality of permits granted for fast breeder power plants has aroused much attention, both in the FRG and in other countries. This is the first time that the German Atomic Energy Act is being questioned with respect to the separation of powers between legislative and executive authorities and also with respect to the principle of a constitutional state. As a result of their analysis of the first information available about the court decision the authors have some doubts as to whether the views held by the court about the consequences of the development of fast breeder reactors and of the permit granted for the SNR 300 demonstration nuclear power station are essentially correct. In view of the wording of and the official comments on the incriminated Section 7 of the Atomic Energy Act and the large number of subsequent leading decisions by the Federal Diet about fast breeder reactors also the concern about the constitutionality of that reactor line appears to be unfounded.

42836 **Building stop for Kernkraftwerk Brokdorf extended.** *Energiewirtsch. Tagesfragen;* **27**: No. 11, 758-759(Nov 1977). (In German).

The Higher Administrative Court at Lueneburg has confirmed in its decision of Oct. 17th, 1977 - VII OVG B 22, 42/77 - the building stop for the Kernkraftwerk Brokdorf with the time limit 'until an application, ready for examination, concerning an intermediate storage site for depositing spent fuel elements has been filed, and geological investigations for proving the suitability of a certain site for the final storage of radioactive wastes have been initiated. Thus, the court heads for a kind of a compromise, the justification and the legal grounds of which one can have different views on: On

the one hand, the nuclear hazard potential, which only takes effect at a much later stage, has here already been anticipated in the interest of future safety in a preliminary legal protection procedure concerning a 1st partial erection licence, thus, without need, intensifying the supply crisis to be expected in meeting the energy demand during the next decade, as well as causing the future operator heavy financial losses. On the other hand, the project as such is not dismissed, but its execution is probably only delayed.

42837 Hessen: ordinance concerning competences in the field of nuclear protection and radiation protection. *Arbeitsschutz (Cologne);* No. 11, 324-327(Nov 1977). (In German).

Competences are described for: 1) licensing of nuclear facilities; 2) use of nuclear fuels; 3) plan approval procedure; 4) supervisory authorities; 5) Radiation Protection Ordinance; and 6) X-Ray Ordinance; 7) proceedings and disciplinary action against breaches of the rules.

42838 Concerning the jurisdiction at the nuclear power site. *Energiewirtsch. Tagesfragen;* No. 10, 715-716(Oct 1977). (In German).

The higher administrative court at Lueneburg has rejected with costs - verdict of Sept. 13th, 1977 - VII OVG B 77/77 - the appeal of a nuclear energy opponent against the refusal of his challenging-of-a-judge-request, and thus against the fixing of an oral hearing in the court of a town situated within the bounds of the nuclear power plant in operation. The main grounds upon which the judgment is based are presented.

42839 Licensing procedures - targets and problems from the point of view of the State. Feldhaus, G. (Bundesministerium des Innern, Bonn (Germany, F.R.)). pp 3 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection; Duesseldorf, F.R. Germany (8 Feb 1977).

Problems, tasks and procedural regulations of the State and integration of the licensing procedure into official control tasks are explained.

42840 Licensing procedures - targets and problems from the point of view of the citizen. Zillessen, H. (Sozialwissenschaftliches Inst. der Evangelischen Kirchen, Bochum (Germany, F.R.)). pp 4 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection; Duesseldorf, F.R. Germany (8 Feb 1977).

This contribution discusses the decisive targets of the licensing procedure and proposals for their realization. Increased citizen participation and a participation-oriented licensing procedure is put forward.

REACTOR DOCKETS

42841 (DOCKET-50277—1247) **Peach Bottom Atomic Power Station, Units 2 and 3. Annual operating report No. 2: January—December 1977 (including corrected Tables 5 and 7).** (Philadelphia Electric Co., Pa. (USA)). 28 Feb 1978. vp. (DOCKET-50278—1131).

Each unit experienced a refueling/maintenance outage and eleven additional outages. Data are presented concerning operations, radiation exposures, radioactive effluents, solid waste shipments, and revisions to previous semiannual effluent reports. (FS)

ECONOMICS

REFER ALSO TO CITATION(S) 43097

42842 Nuclear problems. *Rev. Polytech.;* No. 11, 1253(25 Nov 1977). (In French).

A situation report on the position of nuclear power in the EEC states that the present actual and planned output (mid-1976) totals 91 GW and that although the objective is 125 GW by 1985 the practical figure by then is more likely to be 90 GW. This shortfall is equivalent to 45 Mtonnes of oil and will imply an EEC import in 1985 of 700 Mtonnes or 55% of the total energy requirements. The present state of the Fast Breeder Reactor and High Temperature Reactor are summarised, and the fuel cycle mentioned. The percentage contribution of nuclear power from various European countries in 1976, 1980 and 1985 is tabulated.

42843 Principles of heat utilization on nuclear power stations. Traupel, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 813-817(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

A discussion of the energy balance and thermal efficiency of nuclear power stations is given, based on the second law of thermodynamics. Means of utilization of the low grade waste heat, normally disposed of by secondary cooling, are considered with special attention to possibilities of using this energy for space heating.

42844 Status of nuclear power and its fuel cycle as seen at the Salzburg conference in May 1977. Berger, F.P. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering). *Ann. Nucl. Energy;* **4**: No. 11, 505-514(1977).

The political nature of the Conference, an inevitable result of the challenge to nuclear energy in recent years, is considered by way of introduction. The papers are then discussed in relation to the following aspects; reactions to President Carter's policy; alternative fuel cycles and nuclear systems; energy demand and nuclear power programs; integrated fuel cycle; safety, safeguards and public opinion. The main results are summarised to give a general picture of the outcome of the conference as it appeared to the author.

42845 Chosen problems of nuclear power development in Poland. Felicki, J. *Nauka Pol.;* **23**: No. 1, 5-14(1975). (In Polish).

The chosen problems of nuclear power development in Poland such as: general economic planning, preparation for construction and operation of nuclear power plants with WWER type reactors, preparation for production of the chosen devices for nuclear power plants, application of nuclear power for ship propulsion, utilization of high temperature reactors as heat sources in technological processes, utilization of fast breeding reactors, prospecting, enrichment, processing and reprocessing of nuclear fuels as well as radiological protection aspects are briefly described.

CONSTRUCTION AND OPERATION

REFER ALSO TO CITATION(S) 43136

FUEL CYCLE

REFER ALSO TO CITATION(S) 43118

42846 (RSS-TM—13) **Once-through fuel cycles.** Till, C.E.; Chang, Y.I. (Argonne National Lab., Ill. (USA)). 21 Mar 1978. Contract W-31-109-ENG-38. 25p. Dep. NTIS, PC A02/MF A01.

The fuel utilization characteristics for various once-through cycles and possible improvements are quantified, and key technical issues are identified. To examine the resource implications of the once-through cycle improvements, various deployment scenarios are compared for the nuclear energy supply potential. Finally, a few remarks are made on the reality and illusion of a Pu-free economy.

42847 Energy from the atom. Walton, G.N. (Imperial Coll. of Science and Technology, London (UK). Dept. of Chemical Engineering and Chemical Technology). *Educ. Chem.;* **15**: No. 1, 18-21(Jan 1978).

A brief account is given of the source of nuclear energy, the types of power reactor (thermal and fast reactors) commissioned or under development, the factors involved in processing the irradiated fuel elements, the part played by fast breeder reactors in conserving uranium supplies, and the storage of radioactive waste.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 42402

42848 (AECL—5682) **Cost comparison of nuclear and fossil power for the Alberta tar sands.** Sochaski, R.O.; Smith, D.W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Apr 1977. 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

One technique envisaged for commercial development of the Alberta tar sands is in-situ removal of bitumen by injection of steam into the formation at high temperature and pressure. The 3000 MW of thermal power required for a typical 20 Gg/d plant could be supplied by a nuclear reactor. Accordingly, an economic comparison was made between a CANDU organic-cooled reactor and a conventional coal-fired station, using a variety of financial ground rules. This analysis shows that for debt-financed cases, nuclear power has essentially no economic competition from coal. For equity cases, the competitive position of a coal-fired station is heavily dependent on the cost of coal delivered to the tar sands area, discount rate, amortization period and inflation rate.

42849 (COO—2975-20) **Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period, 1 October 1977—31 December 1977.** (General Electric Co., Schenectady, N.Y. (USA). Energy Systems Programs Dept.). 20

Mar 1978. Contract EY-76-C-02-2975. 57p. Dep. NTIS, PC A04/MF A01.

The objectives of this program are to evaluate candidate alloys for Very High Temperature Reactor Nuclear Process Heat (NPH) and Direct Cycle Helium Turbine (DCHT) applications, in terms of the affect of simulated reactor primary coolant (helium containing small amounts of various other gases), high temperatures, and long time exposures, on the mechanical properties and structural and surface stability of selected candidate alloys. A second objective is to select and recommend materials for future test facilities and more extensive qualification programs. Work covered includes the activities associated with the procurement of the materials for the screening test program and information from vendor certification for the materials received for the nuclear process heat candidate alloys. The design modifications to the helium purification system and the construction status of the simulated reactor helium supply system, testing equipment, and analysis instrumentation and equipment are discussed. Finally, the status and details of the data management are presented.

42850 Electrofluid gasification of coal with nuclear energy. Pulsifer, A.H.; Wheelock, T.D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). *Fuel Process. Technol.;* **1**: No. 2, 117-132(Jan 1978).

The gasification of coal by reaction with steam requires the addition of large amounts of energy. This energy can be supplied by a high-temperature nuclear reactor which is coupled to a fluidized bed gasifier either thermally or electrically via an electrofluid gasifier. A comparison of the economics of supplying energy by these two alternatives demonstrates that electrofluid gasification in combination with a high-temperature nuclear reactor may in some circumstances be economically attractive. In addition, a review of recent experiments in small-scale electrofluid gasifiers indicates that this method of gasification is technically feasible.

42851 Heat utilization of nuclear power stations within the total energy concept. Kiener, E. (Eidg. Amtes fuer Energiewirtschaft, Bern, Switzerland). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 825-827(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

The position of the district heating supplied from nuclear power stations to centres of population is discussed within the total energy concept, whereby all energy requirements of the Swiss economy are considered together with the available resources.

42852 Heat utilization of future reactor systems. Heller, A.; Minder, R. (Electro-Watt Engineering Services Ltd., Zurich (Switzerland)). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 839-843(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

The types of nuclear reactor systems suitable for heat utilization are reviewed comparing the existing designs such as the PWR (pressurized water reactor) and BWR (boiling water reactor) with possible future reactor systems including the LMFBR (liquid metal fast breeder reactor) and HHT (high temperature helium turbine reactor). Next to the high pressure - high temperature advanced technology systems, the prospects of low technology solutions are discussed such as the Swedish SECURE (safe environmentally clean urban reactor) project designed as a pure heat producing plant.

42853 Heat utilization of existing and under construction nuclear power stations in Switzerland. Stoll, P. (Bernische Kraftwerke A.G. (Switzerland)). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 828-833(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

The basic economic and technological principles of heat and power production are discussed, considering in some detail the properties of nuclear power heat transfer-steam generation-condensation systems including Swiss projects and studies. It is shown that the most promising overall solution is based on the principle of nuclear reactor heat utilization as the main load, feeding an extensive and purpose-designed district heating network.

42854 New secondary energy systems. Schulten, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). pp 4 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection; Duesseldorf, F.R. Germany (8 Feb 1977).

As an introduction, the FRG's energy industry situation is described, secondary energy systems to be taken into consideration are classified, and appropriate market requirements are analyzed. Dealt with is district heating, i.e. the direct transport of heat by means of circulating media, and long-distance energy, i.e. the long-distance energy transport by means of chemical conversion in closed- or open-cycle systems. In closed-cycle systems heat is transported in the form of chemical latent energy. In contrast to this, chemical energy is transported in open-cycle systems in the form of fuel gases produced by coal gasification or by thermochemical water splitting.

42855 Possible uses of nuclear energy in agriculture. Vanek, V.; Suchanek, O. *Jad. Energ.;* **23**: No. 3, 112-117(Mar 1977). (In Czech).

The possibilities are indicated of building nuplexes around a nuclear source producing cheap energy in the form of electricity, steam or hot water. Nuclear power plant warm process water will be used for heating hot-houses, irrigating fields and breeding thermophilic fish. The application of radionuclides and ionizing radiation in agriculture is indicated.

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 43099

THEORY AND CALCULATION

42856 (AECL—5907) **Hybrid computer simulation of reactor spatial dynamics.** Hinds, H.W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1977. 18p. (CONF-770939—3). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 3. power plant dynamics, control and testing symposium; Knoxville, TN, USA (7 Sep 1977).

The partial differential equations describing the one-speed spatial dynamics of thermal neutron reactors were converted to a set of ordinary differential equations, using finite-difference approximations for the spatial derivatives. The variables were then normalized to a steady-state reference condition in a novel manner, to yield an equation set particularly suitable for implementation on a hybrid computer. One Applied Dynamics AD/FIVE analog-computer console is capable of solving, all in parallel, up to 30 simultaneous differential equations. This corresponds roughly to eight reactor nodes, each with two active delayed-neutron groups. To improve accuracy, an increase in the number of nodes is usually required. Using the Hsu-Howe multiplexing technique, an 8-node, one-dimensional module was switched back and forth between the left and right halves of the reactor, to simulate a 16-node model, also in one dimension. These two versions (8 or 16 nodes) of the model were tested on benchmark problems of the loss-of-coolant type, which were also solved using the digital code FORSIM, with two energy groups and 26 nodes. Good agreement was obtained between the two solution techniques.

42857 (ECN—18) **Heat transfer and friction on smooth and rough test rods.** Franken, W.M.P.; Hoogland, H.; Deijman, P. (Stichting Energieonderzoek Centrum Nederland, Petten). Jun 1977. 58p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Results are reported on heat transfer and pressure drop tests on one smooth and nine rough test rods in an annular geometry. The wall roughness consisted of transversal ribs with various roughness pitches, rib heights and rib widths. The tests were performed with air as coolant under a wide range of experimental conditions: $10^5 < Re < 6.10^5$, $1.1 < Tsub(w)/Tsub(b) < 2.0$ and 100degC $<=$Tsub(in) $<=$430degC. The results have been transformed to the rod bundle geometry using the simplified transformation method of D.I. Nathan and M.A.M. Pirie. Radial profiles of velocity and temperatue have been measured for the smooth test rod making the use of the Hall transformation possible for this case. The results of the Hall transformation are in good agreement with those of a simplified transformation method. Values of the turbulent momentum and heat diffusivities have been derived from the analysis of the above mentioned velocity and temperature profiles. Friction and Stanton multipliers have been determined from the transformed results on the rough test rods. For the type of roughness investigated the optimal roughness geometry is given by s/e approximately 7, and e/Dsub(hl) approximately 0.005 and w/e >2. Special attention has been given to the effect of variation of the physical coolant properties over the flow cross section. This effect could be described by the power function (Tsub(w)/Tsub(b))sup(-0.3l) in additional systematic variation of the heat transfer could be recognized, dependent on the coolant temperature level. The experimental results were correlated by the equation St = C(Tsub(in)) Resup(-0.2) Prsup(-0.6) (Tsub(w)/Tsub(b)sup(-0.31). Values of C(Tsub(in)) are given in tabular form. The thermal entrance effect has been measured on various test rods. A substantial reduction of the heat transfer coefficient was almost constant along the rough test rods.

42858 (LA—7210-PR) **Reactor technology. Progress report, October—December 1977.** Warren, J.L. (ed.). (Los Alamos Scientific

Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 41p. Dep. NTIS, PC A03/MF A01.

Progress is reported in eight program areas. Steady progress has been made in defining missions and the design of a nuclear Space Electric Power Supply. The Heat Pipe Program has produced two kinds of heat pipes for Hanford Engineering Development Laboratory and significant progress has been made in solving the problem of joining and sealing ceramic tubes for ceramic heat pipes. Under the Nuclear Process Heat Program, there has been an examination of pebble bed reactor design from the point of view of conserving uranium in the fuel cycle. The Plasma Core Reactor experiment produced some data on control rod effectiveness before a leak in the UF_6 pump temporarily halted the experiment. Status and experiments are reported on five critical assemblies, SKUA, Jezebel, Godiva IV, Big Ten, and Flattop-U(93). Several tasks were carried out for the Nuclear Criticality Safety program, including conducting a course, doing several annual reviews, and evaluating the safety of three Nevada Test devices. As part of the Nonproliferation Alternate Sources Assessment Program we have concluded a study of Electro-nuclear Fuel Production and undertaken an evaluation of a study of gaseous core reactors by Southern Science Applications, Inc.

42859 (ND-R—30(R)) **Solution of the time-dependent, multigroup neutron transport equation.** Fletcher, J.K. (UKAEA, Risley. Central Technical Services). Oct 1977. 12p. Dep. NTIS, PC A02/MF A01.

A method has been developed which successfully solves the time-dependent multigroup neutron transport equation with reasonable computer running times. Although specifically devised for reactor physics there is no reason why it should not be applied to other transport equations.

42860 (UCRL—52464) **Dynamic reponse of a cylindrical shell immersed in a potential fluid.** Cummings, G.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1978. Contract W-7405-ENG-48. 147p. Dep. NTIS, PC A07/MF A01.

Thesis.

A numerical solution technique is presented for determining the dynamic response of a thin, elastic, circular, cylindrical shell of constant wall thickness and density, immersed in a potential fluid. The shell may be excited by an arbitrary radial forcing function with a specified time history and spatial distribution. In addition, a pressure history may be specified over a segment of the fluid outer boundary. Any of the natural shell end conditions may be prescribed. A numerical instability prevented direct solutions where the ratio of the hydrodynamic forces to shell inertial forces is greater than two. This instability is believed to be the result of the weak coupling between the equations describing the fluid to those describing the shell. To circumvent this instability, an effective mass was calculated and added to the shell. Comparison of numerical to experimental results are made using a $^1/_{12}$ scale model of a nuclear reactor core support barrel. Natural frequencies and modes are determined for this model in air, water, and oil. The computed frequencies compare to experimental results to within 15%. The use of this numerical technique is illustrated by comparing it to an analytical solution for shell beam modes and an uncertainty in the analytical technique concerning the proper effective mass to use, is resolved.

42861 Hybrid static/dynamic heating technique for the measurement of nuclear Doppler effects. Russell, G.J.; Bhattacharyya, S.K.; Foell, W.K. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Nucl. Instrum. Methods;* **148**: No. 1, 99-111(1 Jan 1978).

A method is presented which utilizes static ohmic heating (from a specially designed irradiation cell) and dynamic fission heating (from an enriched Doppler sample in a pulsed TRIGA reactor) in the measurement of nuclear Doppler effects. This hybrid static/dynamic heating technique provides a very flexible and powerful method for measuring nuclear Doppler effects at extremely high sample-temperatures. The experimental method and irradiation cell used to heat the samples are described. The data reduction and analysis approaches are also discussed. Benchmark experiments using depleted, natural, and approximately 2 wt% enriched UO_2 Doppler pellets, with preheat temperatures as high as 1300 K, demonstrate the feasibility of the method. The resulting pellet temperatures approach the highest temperature (1600 K) for which Doppler measurements have been made for $^{238}UO_2$ in a thermal reactor spectrum using conventional steady-state techniques. The hybrid static-dynamic method has been extended to preheat temperatures of 1700 K and enrichments as high as 12 wt% to drive the peak temperatures of the Doppler pellets beyond the melting point of UO_2 (3115 K).

42862 Analysis of spray cooling of hollow rod cladding following a loss-of-coolant accident (LOCA). Sawan, M.E. (Alexandria Univ. (Egypt). Dept. of Nuclear Engineering). *Atomkernenergie;* **31**: No. 1, 33-37(1978).

An analytical two-dimensional rewetting model is presented to determine the rewetting velocity for a hollow rod cladding during spray cooling process. The effect of the cladding geometry on the rewetting velocity is investigated with the conclusion that the velocity increases with decreasing ratio of inner radius to thickness. The model is used to reduce available experimental data, applicable to rewetting by spray cooling, to yield values of the heat transfer coefficient. Correlations which give the heat transfer coefficient in terms of spray rate, inlet subcooling and pressure are developed. A value of 1.85×10^5 kcal/h x m^2 x °C is recommended for LOCA analysis under spray cooling conditions.

42863 Application of Monte Carlo method in nuclear reactor criticality calculations. II. Algorithm and test problems. Tinka, I. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). *Jad. Energ.;* **23**: No. 3, 81-85(Mar 1977). (In Slovak).

The general diagram is shown of the calculation algorithm of criticality using the Monte Carlo method. Simple geometrical shapes, such as a sphere, a cylinder, etc. were chosen for the description of the individual reactor zones. The principles are presented of the economy of calculations involving the parts of the programme operative in studying each neutron while without significance for the other programme sections. The calculation method was tested for a case of three-dimensional geometry with the cylindrical surfaces of homogeneous zones on GODIVA fast critical assemblies and on the ZR-6 light water critical assembly. Main data and some results of criticality calculations are reported. The results show that a greater number of neutron histories should be studied in order that more reliable values of ksub(ef) may be obtained.

42864 Radiation streaming - the continuing problem of shield design. Avery, A.F. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). *Atomkernenergie;* **30**: No. 4, 261-264(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

The practical problems of shield design are reviewed and the major difficulties are shown to be those associated with streaming problems. The situations in which streaming occurs in various types of reactor are described including LMFBR's and fusion devices, and examples are given of ways in which the problems have been solved.

42865 Cellular body model application to thermohydraulic calculations of reactors and heat exchangers. Gorchakov, M.K.; Kashcheev, V.M.; Kolmakov, A.P.; Yur'ev, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). *Teplofiz. Vys. Temp.;* **14**: No. 4, 866-871(Jul 1976). (In Russian).

A system of equations is presented of an averaged liquid motion in the heterogenetic-anisotropic core of the reactor as in a porous body. Volume forces of non-linear friction, inertial forces and viscous interaction forces between the neighbouring cells were taken into account in above system. An energy equation is given so as to calculate an averaged temperature field in the heterogenetic-anisotropic core of the reactor where an effective coefficient of temperature conductivity is supposed to be a scalar value. To illustrate applicability of this approach for calculation of velocity and temperature macrofields in the reactor core, results of numerical integration of the reduced equation system are presented for a case when there is non-uniformity in the velocity distribution at the inlet and outlet of the fuel element cluster or core. An approximation formula is also obtained to assess relaxation length of the hydraulic disturbance at the core inlet.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 42833, 42834, 43035, 43291

42866 (ASRL-TR—190-1) **Studies of impact-induced responses of a generic crushable-rigid rodlike missile against rigid and deformable targets.** Lush, A.M.; Witmer, E.A. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structure Research Lab.). Sep 1977. Contract EX-76-C-01-2295-023. 281p. Dep. NTIS, PC A13/MF A01.

This study pertains to the analysis of ductile metallic panel protective structures which may be subjected to low-speed impact by missiles of various types and deformabilities, such as steel rods, pipes, poles, rotor blades, rotor disk fragments, aircraft, etc. Since a definitive evaluation of the accuracy and adequacy of theoretical methods for predicting the transient responses of the subject protective structures requires theoretical-experimental comparisons with appropriate well-defined transient structural response data, laboratory experiments to obtain such data were devised and carried out. A generic crushable-rigid rodlike missile consisting of a solid cylindrical front portion of semirigid polyurethane foam and an aluminum

afterbody was designed and tested. High-speed Fastax photographs of this missile with markings on both the foam portion and the aluminum afterbody documented the responses of this type of missile during perpendicular impact against (a) a flat rigid barrier and (b) the midspan of thin deformable aluminum beams with both ends ideally clamped. Also obtained were transient beam profiles and records of transient strain and permanent strain at various spanwise stations of the beam specimens.

42867 Machine tool for turning nuclear parts termed World's largest. *Can. Mach. Metalwork.;* **88**: No. 1, 47(Jan 1977).

The machine tool depicted and briefly described is believed to be the world's largest. It was designed and built by the Ingersoll Milling Machine Co., Rockford, Ill., for Babcock and Wilcox. It is designed to perform multiple machining operations on reactor pressure vessels.

42868 (IWGFR—10, pp 122-131) **Multi-channel acoustic emission surveillance of a pressure vessel during proof test.** Sinclair, A.C.E.; Tobias, A.; Connors, D.C. Jul 1976.

From Meeting on inservice-inspection and monitoring of LMFBRs; Bensberg, German Democratic Republic (9 Mar 1976).

In Specialists meeting on in-service inspection and monitoring of LMFBRs, Bensberg, Germany, F.R., March 9-11, 1976. Summary report.

An acoustic emission analysis system (ACEMAN) designed for acoustic source location was used to monitor the proof test of a steam drum for Inverkip Power Station. The extensive surveillance region included a representative sample of welds and nozzle array complexity. In spite of a large noise background, sophisticated signal discriminators and multi-sensor timing correlation permitted location of several distinct areas of acoustic activity. Differing emission patterns with pressure pointed to a variety of source mechanisms. Factors important to the acoustic emission assessment of structural integrity are discussed.

42869 (N—77-31541) **Strength evaluation of steel structures for low cycle fatique.** Grubisic, V.; Sonsino, C.M. (Laboratorium fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.)). Jan 1977. 50p. (TB—134(1977); ICAF—945). NTIS PC A03/MF A01.

Different structural components as high-pressure vessels for isostatic pressure technology, reactor vessels, containers and pipings used in chemical industry etc. have to be designed for a certain, relatively low number of cycles. For a fail-safe and an optimum design of such structures it is necessary to know the local stress/strain states and the behavior of the material under elastic-plastic cyclic deformations. In this report the basic aspects of elastic-plastic materials behavior under cyclic loading at room temperature are discussed and on the example of high-pressure vessels about the application of low-cycle fatigue and fracture mechanics data as decisive material properties referred. Further, parameters influencing the fatigue behavior of structural components are discussed and the procedure for the service life prediction is described.

42870 (N—78-11434) **Calculation of temperature and humidity fields in massive constructions using the finite element method.** Argyris, J.H.; Warnke, E.P.; Willam, K.J. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). 1977. Contract BMFT-RK-21-I/SBB4. 108p. (ISD—213). NTIS PC A06/MF A01.

The theoretical fundamentals of SMART 2 for the analysis of stationary and transient hygrothermal problems in heterogeneous continuums are described. The SMART (Structure Mechanical Analysis in Reactor Technology) consisting of SMART 1 for statistical calculations and SMART 2 for diffusion calculations, was developed on the basis of ASKA for the calculation of prestressed concrete reactor pressure vessels using the finite element method. One of the fields of applications is the heating or drying of thick walled prestressed concrete pressure vessels under special reactor conditions. The software package can also be used for the calculation of transport phenomena provided the diffusion law is valid.

42871 (N—78-11437) **Finite element calculation of prestressed concrete reactor pressure vessels finite element.** Argyris, J.H.; Faust, G.; Szimmat, J.; Warnke, E.P.; Willam, K.J. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). Mar 1977. Contract BMFT-RK-21-I/SBB4. 73p. (ISD—219). NTIS PC A04/MF A01.

Research and development on prestressed concrete reactor vessel (PCRV) analysis is summarized. Discretization problems were investigated for the finite element idealization of PCRV in addition to questions with regard to long term creep and concrete failure in the ultimate load regime. Special attention was given to the triaxial load conditions in massive structures and the specific concrete properties under hygrothermal environments. The finite element system SMART was programmed for the analysis of prestressed concrete reactor vessels. It consists of two parts: SMART I - Statics; SMART II - Diffusion. SMART serves both to static analysis of stresses and deformations and the computation of hygrothermal boundary conditions in massive structures within a compatible software package.

42872 Development in fracture mechanics and failure assessment. Chell, G.G. (Central Electricity Research Labs., Leatherhead (UK)). *CEGB Res.;* No. 6, 36-42(Jan 1978).

Application of the theories of fracture mechanics can help avoid the type of catastrophic failure that has occurred in structures, eg the failure, whilst undergoing a routine test, of a turbogenerator for Hinkly Point power station. The development is described for a procedure for summarising the salient features of fracture theory as applied to steel structures. This is achieved by the introduction of a relatively simple failure assessment diagram which may be used by unspecialised staff.

42873 Problems, properties and performance of static seals. Chivers, T.C.; Hunt, R.P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). *CEGB Res.;* No. 6, 26-35(Jan 1978).

A general review of static seal and seal leakage research undertaken at Berkeley Nuclear Laboratories is presented. Much of the work in progress has originated from studies of aspects of seal behaviour which are of particular relevance to nuclear technology, but the principles evolved may be applied to many kinds of sealing problem. Examples are drawn from conventional generating plant to illustrate some of the features of these studies.

42874 Cost-risk optimization of nondestructive inspection level. Johnson, D.P. (Failure Analysis Associates, Palo Alto, Calif. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 207-224(Jan 1978).

This paper develops a quantitative methodology for determining the nondestructive inspection (NDI) level that will result in a minimum cost product considering both type one inspection errors, acceptance of defective material units, and type two inspection errors, rejection of sound material units. This methodology represents an advance over fracture mechanics - nondestructive inspection (FM-NDI) design systems that do not consider type two inspection errors or the pre-inspection material quality. The inputs required for the methodology developed in this paper are (1) the rejection probability as a function of inspection size and imperfection size, (2) the flaw frequency (FF), as a function of imperfection size, (3) the probability of failure given the material unit contains an imperfection of a given size as a function of that given size, (4) the manufacturing cost per material unit, (5) the inspection cost per material unit, and (6) the average cost per failure including indirect costs. Four methods are identified for determining the flaw-frequency and three methods are identified for determining the conditional failure probability (one of these methods is probabilistic fracture mechanics). Methods for determining the rejection probability are discussed elsewhere. The NDI-FF methodology can have significant impact where the cost of failures represents a significant fraction of the manufacturing costs, or when a significant fraction of the components are being rejected by the inspection.

42875 Application of elastic-plastic fracture mechanics parameters in fracture safe design. Egan, G.R.; Robinson, J.N. (Failure Analysis Associates, Palo Alto, Calif. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 133-158(Jan 1978).

The report summarizes some of the methods which are currently used for assessing the fracture toughness of materials under elastic and elastic-plastic conditions. The main parameters which are considered are (1) plane strain fracture toughness (Ksub(Ic)), (2) equivalent energy (Ksub(Icd)), (3) contour integral (J) and (4) crack opening displacement (COD). Gross strain crack tolerance and stress concentration methods are also discussed. It is concluded that of these parameters, the contour integral and the crack opening displacement have most potential for future development.

42876 Numerical analysis of circular elastic-plastic plates under cycles of pressure and temperature. Waszczyszyn, Z.; Pablisek, E. (Cracow Technical University, Cracow (Poland). Computer Center). *Nucl. Eng. Des.;* **45**: No. 1, 173-183(Jan 1978).

A numerical approach is considered to compute neutral domains (ND) of elastic response for the so-called load control program (LCP), i.e. for the relation f(P,T)=0, where P and T are pressure and temperature parameters, respectively. Elastic-plastic material with combined isotropic-kinematic strain-hardening is adopted. Material characteristics are assumed to be functions of temperature in incremental equations of the theory of elastic flow. Small strains are assumed but geometrical and equilibrium equations are derived for moderately large deflections. Distribution of temperature in the plate is assumed to be known in every point of the plate xi, as the function (xi, T). The method of solution lies in computation of a sequence of boundary value problems, first along the LCP curve, then along the ND curve. The BV problem is solved by means of forward numerical intregration. Coordinates of points on the ND curve are computed by use of an iterative procedure

which bases on a directed search approach. Computations have been carried out for a sandwich annular plate for linear and piecewise LCP.

42877 Operator representation of failure and repair. Worledge, D.H.; Parry, G.W. (UKAEA Safety and Reliability Directorate, Culcheth). *Nucl. Eng. Des.;* **45**: No. 1, 261-269(Jan 1978).

An operator formalism is presented for writing the solution to the reliability equations for a single component undergoing failure and repair. For the continuous case of faults revealed on failure, the macroscopic time translation operator is built up from the infinitesimal time translation operator. The case where faults are revealed upon inspection is also described, and examples are given to clarify the discussion. Finally, the authors give a brief description of a diagrammatic technique to simplify the writing down of the relevant integral equations, necessary to solve the fixed inspection interval problem.

42878 Use of regeneration diagrams to solve component reliability problems. Parry, G.W.; Worledge, D.H. (UKAEA Safety and Reliability Directorate, Culcheth). *Nucl. Eng. Des.;* **45**: No. 1, 271-276(Jan 1978).

A diagrammatic technique for writing down the integral equations of reliability theory is presented. The way in which time enters the equations is discussed. A simple modification allows the moments of the distributions of interesting quantities to be calculated.

42879 Creep behaviour of the austenitic steel 1,4970 during and after neutron irradiation in the BR2 plant. Wassilew, C.; Schaefer, L.; Anderko, K. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). pp 609-612 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 4. Brennelemente und Brennelement-Werkstoffe. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

42880 Criteria of classification of equipment in nuclear power plants for the purpose of introducing individual weld quality requirements. Bergemann, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). *Schweistechnik (Berlin);* **27**: No. 11, 511-512(Nov 1977). (In German).

Criteria of classification of equipment in nuclear power plants are discussed for the purpose of introducing individual weld quality requirements. Neither the soviet specification PK 1514-72 nor the ASAO 880 regulations can be regarded as satisfying all requirements.

42881 Nuclear reactor. Pennell, W.E.; Rowan, W.J. (to Energy Research and Development Administration). US Patent 4,053,359. 11 Oct 1977. Filed date 17 Mar 1976. 12p.

PAT-APPL-667,734.

A nuclear reactor is described in which the core components, including fuel-rod assemblies, control-rod assemblies, fertile rod-assemblies, and removable shielding assemblies, are supported by a plurality of separate inlet modular units. These units are referred to as inlet module units to distinguish them from the modules of the upper internals of the reactor. The modular units are supported, each removable independently of the others, in liners in the supporting structure for the lower internals of the reactor. The core assemblies are removably supported in integral receptacles or sockets of the modular units. The liners, units, sockets and assemblies have inlet openings for entry of the fluid. The modular units are each removably mounted in the liners with fluid seals interposed between the opening in the liner and inlet module into which the fluid enters in the upper and lower portion of the liner. Each assembly is similarly mounted in a corresponding receptacle with fluid seals interposed between the openings where the fluid enters in the lower portion of the receptacle or fitting closely in these regions. As fluid flows along each core assembly a pressure drop is produced along the fluid so that the fluid which emerges from each core assembly is at a lower pressure than the fluid which enters the core assembly. However because of the seals interposed in the mountings of the units and assemblies the pressures above and below the units and assemblies are balanced and the units are held in the liners and the assemblies are held in the receptacles by their weights as they have a higher specific gravity than the fluid. The low-pressure spaces between each module and its liner and between each core assembly and its module is vented to the low-pressure regions of the vessel to assure that fluid which leaks through the seals does not accumulate and destroy the hydraulic balance.

42882 Calculation of pressure vessels. Ringelstein, K.H. *Tech. Ueberwach.;* **18**: No. 10, 335-338(Oct 1977). (In German).

The calculation guidelines of the Arbeitsgemeinschaft Druckbehaelter (task group for pressure vessels) have been revised with the following objective: conversion to international standards (SI), adaption to the latest state of guidelines for production and testing, revision of the contents of individual regulations. Another target of the cooperating interest groups of producers, operators, and supervisory bodies was a harmonization of the approaches for calculation with other German guidelines, in particular the Technische Regeln fuer Dampfkessel (technical regulations for steam boilers).

42883 Coordination could ease containment-heat woes. *Electr. World;* **188**: No. 5, 33-34(1 Sep 1977).

A total systems approach—rather than separate engineering investigations within each nuclear service-support system—may solve the problem of unanticipated excess heat within a nuclear containment, according to a group of nuclear industry people. The group comprised representatives of utilities, architect engineers, and manufacturers of nuclear reactors, reflective insulation and air-conditioning systems. Suggestions on how to establish criteria for heat-loss control ranged from putting the air-conditioning expert or insulation manufacturer in charge of the problem to requesting action by a committee of ASTM. The consensus, however, was the industry should look at the problem as a whole rather than attempting to find solutions on a component basis.

42884 Karlsruhe computer program for the evaluation of the availability and reliability of complex repairable systems. Caldarola, L.; Wickenhaeuser, A. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 463-470(Sep 1977).

A very fast analytical computer program for fault tree evaluation has already been developed at the German Nuclear Research Center of Karlsruhe. This program can solve coherent systems in binary logic. Four different classes of components can be handled by the program: 1. Unrepairable components. 2. Repairable components with failures which are immediately detected (revealed faults). 3. Repairable components with failures which are detected upon demand (faults remain unrevealed until next demand occurs). 4. Repairable components with failures which are detected upon inspection (faults remain unrevealed until next inspection is carried out). The program can perform also time dependent calculations. In particular the program can analyse systems characterized by two phases one following the other in time (two time axis). A numerical example is also included.

42885 Water cooling in nuclear reactors by using panels of integrated circuits. Dominique, P.; Letissier, R. *Rev. Alum.;* No. 464, 325-328(Jul 1977). (In French).

In view of the drawbacks of wet cooling towers, EDF is searching for another approach to the problem. A self-cleaning device is now envisaged, that consists of some exchanger plates, 30 to 40m height (max. 60m) capable of being hiden in the lanscape behind high trees. The plates would be rather smooth and the air circulated by natural convection. The prototype is composed of 960 aluminium panels of integrated circuits mounted on three modules made of tubular elements working as supporting and collecting means together.

42886 Structural reliability and its proving in reactor technology. Ando, Y.; Yagawa, G. (Tokyo Univ. (Japan). Faculty of Engineering); Kawai, T.; Omori, T.; Ono, T. *Nippon Genshiryoku Gakkaishi;* **19**: No. 6, 356-379(Jun 1977). (In Japanese).

Reactor pressure vessels compose a part of pressure boundary, for which highest reliability and safety are required among the structural equipments of light water reactors, and the design and manufacture are carried out at the highest technological level at present. In order to maintain the function for 40 years of the life, it is necessary to confirm the safety margin to the breaking due to all external force as accurately as possible. The preventive measures to brittle fracture determined by ASME on the basis of the fracture mechanics are explained. But in the actual application to the design of reactor pressure vessels, the problems of dynamic fracture toughness, the derivation of the stress intensifying factor for complex three dimensional cracks, the effect of plasticity, and the effect of irradiation remain. The recent researches in the heavy section steel technology in USA, the final strength analysis for structures according to the new discrete model, the plan to carry out the proving test on the aseismatic reliability of nuclear power generation facilities, the aseismatic design and the reliability of nuclear power stations, and the reliability of structures in the aseismatic design of nuclear power stations are discussed. The conference on structural mechanics in reactor technology is scheduled in August, 1977, in San Francisco, and this feature article is the introduction to this field.

42887 Method and apparatus for controlling surface traversing device. (to Combustion Engineering, Inc., New York (USA)). Netherlands Patent 7,703,275/A/. 25 Mar 1977. Priority date 26 Mar 1976, United States of America (USA). 52p. (In Dutch).

A method and apparatus are provided for controlling the movement of a surface traversing apparatus across the pipe plate of a

nuclear steam generator which has an ordered array of openings in its surface. A number of automatic move control routines are provided which are respectively operative to move the traversing apparatus incrementally over the surface of the plate by disengaging a pair of stepping arms. Each move routine senses the relative positioning of the two stepping arms to establish the sequence of operations required to move the traversing apparatus an increment in the appropriate direction. Each move routine provides for returning a stepping arm to a former position should it be unable to satisfactorily engage the plate following a move step. The move control routines may be stored in a properly programmed digital controller for execution in response to a selection operation which may be either semi-automatic or automatic, the latter serving to move the traversing apparatus toward a target opening in the array by comparing the present location of the apparatus with the target address and selecting the appropriate move routine. This selection is done such as to minimize the number of move increments utilized in attaining the target.

42888 Method for the utilization of heat generated in an electric power plant. Cahn, R.P. (to Exxon Research and Engineering Co., Linden, N.J. (USA)). German(FRG) Patent 2,640,789/A/. 24 Mar 1977. 49p. (In German).

For a better adaptation of the output of a nuclear or fossil-fuel power plant to the great changes in power demand, it is proposed to store the excess heat during low-demand periods in a high-temperature storage unit with the aid of an organic material (hydrocarbon fraction, e.g. vacuum gas oil) and to use it directly for intermediate-pressure steam generation etc. during high-demand periods. The use according to the invention of movable heat carrier substances allows an optimum utilisation of the rotational speed of turbine and generator. Also the plant responds easily to changing demands. Many possible variations are described in detail.

42889 Environmental tests of electric cables for nuclear power plants. Oda, E.; Uchida, K.; Fujimura, S.; Oya, S.; Takagi, Y. (Furukawa Electric Co. Ltd., Tokyo (Japan)). *FAPIG (Tokyo);* No. 84, 24-32(Feb 1977). (In Japanese).

The evaluation of the materials for flame retardation of cables for nuclear power plants and the tests of their environmental resistivity are reported. Several cables to meet the severe requirements for these cables have been produced for trial, which have been subjected to the simulated environment test including Loss of Coolant Accident. The results are summarized as follows: (a) the ethylene-proylene rubber-insulated, chloroprene-sheathed cable has the sufficient properties to use in BWR containment vessels, such as radiation resistance and flame resistance. (b) It is the same in the chloroprene-sheathed cable, that has glass braids on the outermost layer and around each core, and the insulation layer of the silicone rubber electrically stable but mechanically low in radiation resistivity. (c) The flame-resistant cross-linking polyethylene-insulated, low hydrochloric acid vinyl-sheathed cable is usable near but outside BWR containment vessels. (d) The flame-resistant cross-linking polyethylene-insulated, chloroprene-sheathed cable having the insulating layer of polyethylene for each core can be used in PWR containment vessels. (e) Chloroprene and polyvinyl chloride, the flame-resistant sheath materials, deteriorate owing to heat aging alone. Only the insulating layers mainly contribute to the environmental resistivity of cables. (f) The environmental conditions are severer when heat aging is carried out prior to irradiation. The influence of dose rate is rather little.

42890 Leakage characteristics for pressure vessel appurtenances. Fukue, H. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). *Atsuryoku Gijutsu;* **14**: No. 6, 293-302(Nov 1976). (In Japanese).

The leakage of gas or liquid from pressure vessels is affected by the pressure and temperature within the pressure vessels, the form, length and surface condition of leaking passages, viscosity, and the mean free path of gas. The leakage is roughly classified into molecular diffusion, molecular flow, laminar or viscous flow, turbulent flow, and compressible or orifice flow, and the equations for calculating leaking flow rate in respective flows are given as the functions of temperature and pressure. The example of measurement of very small leakage characteristics and the example of analysis of leakage characteristics are shown. Reactor containment vessels are installed for preventing scattering of harmful radioactive substances, and the total leakage rate test is carried out at the time of plant completion and periodical inspections. The allowable leakage rate in A type leakage test is calculated. The parts where leakage is expected are limited to appurtenances, such as valves, air lock seats and cable-penetrating parts, in view of the construction of containment vessels. Accordingly, as the experiment on the leakage characteristics, the artificial leaking hole was made and fixed to the vessel, and the relation between the pressure in the vessel and leakage quantity was measured. The results are shown besides the results of leakage rate test.

42891 Method and plant to remove tritium from the cooling water of a nuclear reactor. O'Brien, C.J. (to Aerojet-General Corp., El Monte, Calif. (USA)). German(FRG) Patent 2,545,001/A/. 13 May 1976. 13p. (In German).

A method is proposed for the extraction of tritium from the cooling water of a nuclear reactor, based on the principle of concentrating the tritium by a multi-stage transfer process. The cooling water is brought into contact in each stage with basic, labile, hydrogen-containing material with high pH value, whereby the tritium is transfered into an intermediate solid product and can be separated off. The technical details of the plant are described. Cellulose materials, such as cotton and wood as well as protein-containing material, such as muscle tissue are mentioned as examples of materials with a high affinity to tritium, greater than the affinity of water to tritium. They extract tritium from the cooling water.

42892 Apparatus for measuring and controlling quantity of drain waste from a primary container in an atomic power plant. Nakajima, K. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-73298/A/. 13 Dec 1975. 5p. (In Japanese).

A method to mount a sump pump, a system for measuring the rate of change in quantity of flow-in liquid, and an alarm display system on a drain waste storage tank to early discover failure of a primary container, piping and the like is described. A liquid level of drain waste in a primary container collected in a sub-tank and stored in a main tank is detected by a level detector element, read into a process input and output device and compared with upper and lower limit preset levels and operated by an operator device, and when the first-mentioned level exceeds the upper limit preset level, the sump pump is driven to effect release of flow, whereby the released flow detected by the flow measuring element is read into the process input and output device, and at the same time, the alarm display operating and indicating device and the protective system in the atomic power plant are actuated.

42893 Holder of a neutron measuring instrument. Ishii, Y. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-72088/A/. 10 Dec 1975. 4p. (In Japanese).

A method to easily mount and remove a neutron measuring instrument is described. A holder is formed with a concave portion to hold an upper end of a neutron measuring instrument, the holder being mounted on one end of a rod which extends through a grid, the rod having the other end held by a handle. A spring is retained between the grid and the holder. With this structure, when the neutron measuring instrument is removed, the handle is raised and the holder is raised against the spring, and then the upper end of the neutron measuring instrument in engagement with the concave portion of the holder is removed using a pair of tongs. This procedure described above eliminates trouble such as falling of the neutron measuring instrument caused by erroneous operation of the tongs experienced in the past.

42894 Device for regulating the position of fuel supporter. Ito, Y.; Hattori, N.; Izumi, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-67488/A/. 1 Dec 1975. 5p. (In Japanese).

A method to permit smooth mounting of a fuel assembly in reactor core through accurate regulation of the position of a fuel supporter carried out by selectively operating a plurality of urging members provided on the outer periphery of the fuel supporter according to the rotational angle of the same is described. When the fuel supporter is rotated by +45 degrees for bringing the fuel assembly having been transferred from a wagon to the reactor core to an inclination of +45 degrees, an actuator touches a limit switch provided at a predetermined position to energize a solenoid, thus causing an urging member at a predetermined position to urge the fuel supporter into an orientation of +45 degrees. In this way, the fuel assembly can be smoothly inserted into the fuel assembly without causing contact between fuel fasteners.

42895 Pool for storing spent nuclear fuel. Takahara, A. (to Toyo Engineering Corp., Tokyo (Japan)). Japanese Patent 1977-63599/A/. 19 Nov 1975. 5p. (In Japanese).

A method to adequately detect defects in case where a small defect occurs in a pool body, and to completely prevent leak-out radioactive material is described. A gap portion is provided between a pool body, which is a metal container adapted to hold and store cooling water for cooling assembly of spent nuclear fuel rods and nuclear fuel rods, and a concrete bed, which is a reinforced concrete supporting structure for supporting said pool body, and water of the same as or similar composition to cooling water is held in said gap portion under pressure higher than that of cooling water within the storage pool. A specific chemical material can be put into the thus filled cooling water to serve as monitoring in detection of a defect and in assumption of size thereof. If the pool body should be damaged, the filled water would be leaked into the pool body. In this case, however, the filling water may be replenished to maintain the

pressure of filling water higher whereby leak-out of radioactive material in the cooling water may completely be avoided.

42896 Monitoring device of the interior of a reactor. Shirayama, S.; Fujii, I. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-52093/A/. 24 Oct 1975. 3p. (In Japanese).

A method to incorporate a sound detecting piezo-electric element into a container receiving therein an electrode, which serves as an ionization chamber for detecting neutron flux, to detect both the neutron flux and sound by means of one device is described. When a DC power source is closed and a conversion material is reacted as a result of irradiation of neutron between the electrode and the container in a detecting station, an ionization current is flown and a voltage drop is appeared between both ends of a resistor in a system of processing radioactive rays signal to detect the neutron flux which is displayed by a display device, and when a sound is produced within a reactor, the bottom wall is deformed and as a result, a power is produced between the opposite sides of the piezoelectric element, said power being removed through a filter in a system of processing sound signals, which is displayed by another display device.

42897 Monitoring method of an atomic power plant. Koba, A.; Goto, S.; Ohashi, H. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-52091/A/. 22 Oct 1975. 4p. (In Japanese).

A monitoring vehicle loaded with various detecting elements which along a monorail disposed so as to surround various devices to thereby early discover various abnormal conditions is described. The monitoring vehicle moves on the monorail disposed so as to surround the periphery of various devices in an atomic power plant so that detection signals from an ITV camera, temperature and radioactive rays and sound detecting elements, and the like are received through a slide contact between the wheel and transmitting and receiving line disposed in the wheel groove to transmit the signals to a central control panel.

42898 Feedwater control system for a nuclear power plant. Sugiyama, S.; Omori, T.; Tanji, J.; Furukawa, K.; Imaizumi, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-43099/A/. 3 Oct 1975. 4p. (In Japanese).

A method to quickly and accurately control reactor water level even at the time of a sudden decrease in the turbine steam stream by the provision of an escape valve model which can accurately estimate the flow rate of the main steam stream is described. An escape valve model calculates the valve flow rate based on the turbine input pressure from a pressure detector and bypass flow from a main steam flow rate detector, and a first adder calculates the actual main steam flow rate from the escape valve flow rate and bypass flow rate. The actual main steam flow rate and feedwater flow rate are coupled to a second adder. Meanwhile, the difference between the reactor water level and a preset water level is coupled through a converter to the second adder, and the output therefrom is coupled to a control gauge for on-off control of the feedwater valve.

42899 Fastening device of component elements in nuclear reactor. Tatemichi, S. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-27991/A/. 26 Aug 1975. 3p. (In Japanese).

A method to provide a reactor component element fastening device, which can suppress vibration of the neutron detector assembly within the reactor due to flow of reactor water or earthquake and is capable of mounting and removal within the reactor is described. This fastening device is formed by bending a ribbon-like metal member having a curved portion complementary to the corner curved surface of a channel box of the fuel assembly into a channel-shaped form. It is inserted between the fuel assembly and neutron detector assembly so that it strides a core top grating member, and its rising due to flow of the reactor water is prevented by means of a fastener.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 43857

42900 (PNL—2434) **GAPCON-THERMAL-3 code description.** Lanning, D.D.; Mohr, C.L.; Panisko, F.E.; Stewart, K.B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 330p. Dep. NTIS, MF A01.

GAPCON-3 is a computer program that predicts the thermal and mechanical behavior of an operating fuel rod during its normal lifetime. The code calculates temperatures, dimensions, stresses, and strains for the fuel and the cladding in both the radial and axial directions for each step of the user specified power history. The method of weighted residuals is for the steady state temperature calculation, and is combined with a finite difference approximation of the time derivative for transient conditions. The stress strain analysis employs an iterative axisymmetric finite element procedure that includes plasticity and creep for normal and pellet-clad mechanical interaction loads. GAPCON-3 can solve steady state and operational transient problems. Comparisons of GAPCON-3 predictions to both closed form analytical solutions and actual inpile instrumented fuel rod data have demonstrated the ability of the code to calculate fuel rod behavior. GAPCON-3 features a restart capability and an associated plot package unavailable in previous GAPCON series codes.

42901 (IAEA-CN—36/342) **Safety of sodium-cooled fast reactors.** Bagdasarov, Yu.E.; Matveev, V.I.; Kuznetsov, I.A.; Krasnoyarov, N.V.; Kochetkov, L.A.; Kulakovsky, M.Ya.; Pomerantsev, G.B. Apr 1978. Translation of USSR paper. (CONF-770505—54(trans)). 21p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear power and its fuel cycles; Salzburg, Austria (2 May 1977).

Some physical and technical aspects of sodium-cooled fast reactor safety are discussed. An approach to the solution of safety problems used in the designs of the USSR first fast-reactor generation was based (as a result of thermal-reactor operating experience) on a logical analysis of the tree of failures, on careful development and testing of safety systems and devices, and on duplication and echelonment of the most important of them. A review of main works carried out for the last two decades is given and the most important results of design studies, research and operating experience obtained on fast reactors as to accumulation of data and characteristics in the area of safety are presented.

42902 Temperature distributions in a system of two cylindrical bodies. Shukla, K.N. (Vikram Sarabhai Space Centre, Trivandrum (India)); Pandey, R.N. (Banaras Hindu Univ. (India). Inst. of Tech.). *Int. J. Heat Mass Transfer;* **20**: No. 12, 1351-1354(Dec 1977).

Transient heat transfer in a cylindrical fuel element of a nuclear reactor is considered. The fuel road, whose power dissipation is assumed to take place in the fuel element by a sinusoidal pulse, and the cladding are separated by a thin layer. The conjugate boundary-value problem involving the equation for heat conduction in the fuel rod and cladding, and boundary conditions with regard for non-ideal thermal contact is solved by the Laplace transformation. Results for temperature distribution for uranium dioxide fuel rod and zirconium cladding when cooled by liquid sodium are presented graphically.

42903 Ceramics as nuclear reactor fuels. Reeve, F.D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). *J. Aust. Ceram. Soc.;* **3**: No. 2, 38-47(Nov 1977).

The role of ceramic materials in both metal clad and all-ceramic fuel designs is surveyed. At present the balance between metal clad ceramic and all-ceramic fuels is very much in favour of the former. For coolant temperatures in the range 300-600°C, for which suitable alloys such as zirconium alloys and stainless steels are available, metal clad UO_2, modified by addition of ThO_2 or PuO_2 if appropriate, has been adopted as a commercial fuel on a large scale, and is used in most of today's commercial reactor systems. However, all-ceramic fuels are already being used in reactors with coolant temperatures above 750°C, and as requirements for still higher temperatures arise all-ceramic fuels will become still more important.

42904 Analytic solutions to mass transport equations for cylindrical nuclear fuel elements. Clement, C.F. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). *J. Nucl. Mater.;* **68**: No. 1, 54-62(Sep 1977).

The transport equation characterizing pore movement has several analytic solutions depending on the form of the pore velocity. Properties of this equation are examined with special reference to boundary conditions, movement of turning points where the porosity is stationary, and the possibility of formation of rings of increased porosity. Solutions of the equation with a source term are also obtained. The equations for solid state mass transfer in temperature gradients, where the motion is diffusive, have similar asymptotic solutions for sufficiently small times whose explicit forms are obtained as functions of the diffusivity and heat of transport. These analytic solutions enable simple estimations to be made of the time necessary to redistribute material out to a given radius in terms of the basic parameters.

42905 Movement of lenticular pores in UO_2 nuclear fuel elements. Clement, C.F. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). *J. Nucl. Mater.;* **68**: No. 1, 63-68(Sep 1977).

A simple theory is developed which describes the motion of lenticular pores in a temperature gradient and takes into account evaporation and condensation rates in the pore surfaces. This mechanism, rather than diffusion within the pore is likely to govern the

pore motion if the pores are filled with helium, and it also gives the experimentally favoured Tsup(-5/2) temperature-dependent factor in the pore velocity. Experimental velocities for UO_2 are reproduced quite well by the theory provided that the O/U ratios were slightly greater than 2 in the hot pore region. At temperatures around 2000 K the latter ratio is critical in giving the equilibrium vapour pressure in the pore and hence the pore velocity.

42906 Device for the storage of fuel elements. Schoener, K. (to Licentia Patent-Verwaltungs-G.m.b.H., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,235,796/C/. 18 May 1977. 4p. (In German).

It is proposed to simplify known holder systems for the fuel elements of nuclear facilities in such a way, that the storage space needed gets smaller and the transport ways shorter. A particularly advantageous design of a holder is described.

42907 Process and equipment for locating defective fuel rods of a reactor fuel element. Jester, A.; Honig, H. (to Babcock - Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). German(FRG) Patent 2,424,431/B/. 17 Feb 1977. 4p. (In German).

By this equipment, well-known processes for determining defective fuel rods of a reactor fuel element are improved in such a fashion that defective fuel rods can be located individually, so that it is possible to replace them. The equipment consists of a cylindrical test vessel open above, which accommodates the element to be tested, so that an annular space is left between the latter's external circumference and the wall of the vessel, and so that the fuel rods project above the vessel. A bell in the shape of a frustrum of a cone is inverted over the test vessel, which has an infra-red measuring equipment at a certain distance above the tops of the fuel rods. The fuel element to be tested together with the test vessel and hood are immersed in a basin full of water, which displaces water by means of gas from the hood. The post-shutdown heat increases the temperature in the water space of the test vessel, which is stabilised at 100°C. In each defective fuel rod the water which has penetrated the defective fuel rod previously, or does so now, starts to boil. The steam rising in the fuel rod raises the temperature of the defective fuel rod compared to all the sound ones. The subsequent measurement easily determines this. Where one can expect interference with the measurement by appreciable amounts of gamma rays, the measuring equipment is removed from the path of radiation by mirror deflection in a suitably shaped measuring hood.

42908 Process for tightly sealing nuclear reactor fuel rods. Drescher, R.C.; Yeo, D. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). French Patent 2,305,827/A/. 24 Mar 1976. Priority date 24 Mar 1975, United States of America (USA). 8p. (In French).

This invention refers to a process for pressurising and tightly sealing fuel rods used in nuclear reactors. The fuel rods utilised in commercial nuclear reactors are usually composed of a zircaloy tubular cladding of around 15 mm in diameter and up to 5 m long, filled with fuel pellets maintained in place by end plugs sealed on each end of the cladding. The main purpose of the invention is to promote a process using laser beam welding equipment to seal the end plugs on the fuel rods, drill a pressurising hole in one of the end plugs and hermetically seal the hole after the fuel rod has been placed under pressure.

42909 Nuclear fuel element. Une, K. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-72094/A/. 11 Dec 1975. 4p. (In Japanese).

A method to form a gas atmosphere in fuel rods into an oxide atmosphere during the operation of reactor to always cover the surface within a clad tube with an oxide film thereby avoiding occurrence of hydrogen brittleness and stress corrosion cracking of zircalloy clad tube is described. In a nuclear fuel element wherein a zircalloy clad tube is interiorly filled with uranium oxide sintered pellets, sintered solid oxide pellets, which discharge oxygen at high temperatures, are disposed at the end of fuel pellets. The aforesaid solid oxide is selected from at least one kind of oxide of UO_3, CuO, Co_3O_4, V_2O_5, Mn_2O_3.

42910 Lattice for supporting nuclear reactor fuel assembly. Kishi, Y.; Ueno, N.; Kumagai, H. (to Nuclear Fuel Industries Ltd., Tokyo (Japan)). Japanese Patent 1977-66185/A/. 28 Nov 1975. 5p. (In Japanese).

A method to hold a fuel rod in a precise position within a reactor core while also providing a proper holding force is described. In each cell of the support lattice penetrated by a fuel rod, elastic members and corresponding stationary members are disposed such that they lie in the same horizontal plane, and two pairs of an elastic member and corresponding stationary member are provided in the vertical direction. In other words a total of four such pairs are provided within each cell, so that the fuel rod is supported at eight points. In this way, the fuel rod is supported in the support lattice in a nearly secured state substantially at the opposite ends. This permits a great improvements in the holding performance compared to the former six-point support.

42911 Method of measuring the degree of burnup of reactor fuel. Yokoyama, T.; Watanabe, S. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-63594/A/. 21 Nov 1975. 2p. (In Japanese).

A way to use an external neutron source of known strength irrespective of multification effect of neutron to thereby determine the number of neutron release for measurement of the degree of burnup of reactor fuel is described. A neutron source of known strength is placed in a system composed of spent fuel and medium, the ratio of neutron flux prior and after placement of the neutron source is measured by a neutron detector, and said ratio of neutron flux is used to obtain the number of neutrons released from the spent fuel. Then, the degree of burnup of reactor fuel may be measured from calibration curve of the degree of burnup and the number of neutrons.

42912 Method of measuring the reactivity of reactor fuel. Yokoyama, T.; Makino, K.; Watanabe, S. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-63595/A/. 21 Nov 1975. 2p. (In Japanese).

Object: To measure the reactivity of reactor fuel in a simple and easy way. Structure: The medium in the periphery of the reactor fuel is replaced by a material different in nuclear nature to vary reaction of a system composed of fuel and material in the periphery thereof, and variation in neutron produced thereby is measured by a neutron detector to measure the reactivity of reactor fuel.

42913 Nuclear fuel element. Maru, A.; Hosokawa, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-60393/A/. 14 Nov 1975. 4p. (In Japanese).

A method to reduce stress concentration onto a clad pipe due to thermal deformation of nuclear fuel element, particularly, ridging deformation in the neighbourhood of upper and lower ends of pellet, and to prevent rupture of the clad pipe is described. In a nuclear fuel element in which the nuclear fuel material is enclosed in a clad pipe, the nuclear fuel material comprises a cylindrical outer shell and a columnar inner shell inserted internally of said outer shell in small spaced relation, and lubricating material such as graphite is arranged in the aforesaid spacing.

42914 Fuel assembly for nuclear reactor. Kamo, Y.; Ajima, F. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-41790/A/. 29 Sep 1975. 5p. (In Japanese).

A method to protect the fuel rod from damage due to the heat cycle and thus prevent bending stress from being produced in the fuel rod is described. In a fuel assembly where fuel rods are held together with a water rod between lattice-like spacers, springs each having one end secured to the outer wall of the water rod, the other end of the spring being free, are provided. A plurality of these springs are provided around the outer periphery of the water rod and extend parallel to the axial direction of the rod.

42915 Improvements in nuclear reactors. Pearson, K.G. (to UKAEA). Australian Patent 75/84,166/A/. 21 Aug 1975. 9p.

A nuclear fuel element is described, comprising a cluster of nuclear fuel rods seperated by transverse grids so as to define interspaces for the axial flow of reactor coolant. At least one of the spaces is occupied by an axially extending auxilliary coolant, conduit with lateral holes through which an auxilliary coolant is sprayed into the cluster. The invention in particular describes a deflector means extending from the transverse grid into a position in front of the holes for deflecting the auxilliary coolant spray on to parts of the fuel rods inaccessible to auxilliary coolant.

42916 Improvements in or relating to nuclear reactor fuel elements. Redpath, W.; Read, R.W. (to UKAEA). Australian Patent 75/83/874/A/. 12 Aug 1975. 14p.

The invention relates to nuclear reactor fuel element assemblies in which the coolant employed is light or heavy water. The assembly is one in which nuclear fuel rods are supported in a cluster and spaced apart by transverse grids so that the spaces between the rods form sub-channels through which main reactor coolant is passed. In order to provide auxilliary cooling it is proposed that auxilliary cooling conduits be located amongst the cluster of fuel rods. These conduits have coolant ejection holes in the wall arranged circumferentially in a predetermined pattern which is determined by the position of the conduit in the cluster and by the axial distance of the ejection hole along the conduit.

CONTROL SYSTEMS

42917 Application of the PRS 4000 type process computing system to the Rheinsberg nuclear power plant. Baldeweg, F.; Enkelmann, W.; Klebau, J.; Seidler, S.; Ziegenbein, D. (Zentralinstitut fuer

Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Oehmigen, A. (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic). Betriebsteil Kernkraftwerk Rheinsberg). *Kernenergie;* **21**: No. 4, 100-103(Apr 1978). (In German).

A process computing system of the PRS 4000 type has been installed in the Rheinsberg nuclear power plant for performing reactor diagnostics studies. Hardware and software of the system are described; extensions provided for are considered.

42918 Automation of nuclear power plants. 1. Missbach, M.; Sukrow, S. (VEB Kombinat Kraftwerksanlagenbau, Berlin (German Democratic Republic)). *Kernenergie;* **21**: No. 3, 69-72(Mar 1978). (In German).

Referring to a progress report published in Kernenergie No. 5/1971, the recent development of automation in nuclear power plants since 1970 is described, and the most significant trends of future development are characterized. In this part the nuclear instrumentation of reactors and process computer techniques are considered.

42919 Prestressed pressure vessels. Rigg, S.; Ackroyd, R.T. (to UKAEA). British Patent 1,491,462/A/. 9 Nov 1977. 4p.

Reference is made to prestressed reactor pressure vessels formed from assembled metal parts. The parts have abutting faces with sealing layers between the abutments formed by layers of metal having a lower creep strength than the metal piece parts. A leak tight lining is provided within the vessel. At least one sealing layer may be formed by metal spraying the faces of the piece parts that abut after assembly. The vessel may include a cylindrical barrel portion formed from an assembly of coaxial rings around which is wound peripheral prestressing cable, with end closures for the barrel portion in the form of re-entrantly domed metal plates. The end closures may be held in position by double ended bolts that extend through mating holes in the coaxial rings, the bolts affording axial prestressing for the barrel portion. The abutting edges of the coaxial rings may be caulked by metal sprayed after assembly.

42920 Nuclear reactor remote disconnect control rod coupling indicator. Vuckovich, M. (to Energy Research and Development Administration). US Patent 4,053,355. 11 Oct 1977. Filed date 14 Oct 1975. 10p.

PAT-APPL-621,994.

A coupling indicator for use with nuclear reactor control rod assemblies which have remotely disengageable couplings between the control rod and the control rod drive shaft is described. The coupling indicator indicates whether the control rod and the control rod drive shaft are engaged or disengaged. A resistive network, utilizing magnetic reed switches, senses the position of the control rod drive mechanism lead screw and the control rod position indicating tube, and the relative position of these two elements with respect to each other is compared to determine whether the coupling is engaged or disengaged.

42921 Liquid cooled and moderated nuclear reactor. Rickert, R.J. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German(FRG) Patent 1,639,171/C/. 7 Jul 1977. 8p. (In German).

The claim relates to an arrangement of control rods, or guide tubes for these in a fuel element. For a 12 x 12 or 14 x 14 grid of fuel rods, there are 5 guide tubes, each of which occupies the space of 4 adjacent fuel rods. The purpose of the arrangement is a favourable flux distribution, i.e. an even flux with a load density close to the maximum value.

42922 Conception of modern power station control rooms. Herbst, L. *BBC-Nachr.;* **59**: No. 10, 417-423(1977). (In German).

The dimensions and complexitiy of todays's power plants as well as new potentials for computer-assisted information systems gave rise to the development of a new control room concept. The considerations leading to this concept and the essential design features of modern power station control rooms will be discussed.

42923 MOSIM: a modular simulation system for power station processes. Zimmermann, H. *BBC-Nachr.;* **59**: No. 10, 424-429(1977). (In German).

Before constructing complex systems such as power stations, extensive investigations must be conducted. Simulation on computers is particularly important in determining the dynamic response. MOSIM provides an efficient means of simulating power station processes. The author of this article demonstrates how MOSIM can help in solving dynamic, predominantly process control problems at all stages of the project.

42924 Control rod drives. Tanaka, J. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-72087/A/. 12 Dec 1975. 6p. (In Japanese).

A method to perform maintenance and inspection easily is described. This invention is characterized by division into an upper control rod driving device, which requires more in number of maintenance and inspection, and a lower control rod driving device, which requires less in number of maintenance and inspection. That is, the upper control rod driving device is provided with a driving means and the lower control rod driving device is provided with a control rod holding means and a scram accelerating means for accelerating the falling of the holding means at the time of urgent stoppage of reactor. With this construction, each of driving devices can be separated and individually carried by cask and gases to be fed into the scram accelerating device may be used as gases for operating the control rod holding device so that a single source of gas supply will suffice.

42925 Reactor. Natori, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-70298/A/. 8 Dec 1975. 4p. (In Japanese).

A method to change the concentration of a neutron absorber in each region of moderator by means of a common concentration control device to flatten power distribution is described. In a reactor, wherein a moderator region in a core is divided into a plurality of regions, and the concentration of a neutron absorber in the moderator is changed every region thereof, a system selecting device is disposed between a device for controlling concentration of neutron absorber and a moderator circulating loop to change the concentration of a neutron absorber in each region of moderator by means of a common concentration control device.

42926 Device for coupling a control rod and control rod drive. Nishioka, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-67490/A/. 3 Dec 1975. 4p. (In Japanese).

A method to obtain simple and reliable coupling between a control rod and control rod drive by equipping the lower end of the control rod with an extension provided with lateral protuberances and forming the upper end of an index tube with a recess provided with lateral holes is described. The tapering central extension of the control rod is inserted into the recess by lowering the control rod, and then it is further inserted by causing frictional movement of the inclined surfaces of lateral protuberances in frictional contact with guide surfaces. When the lateral protuberances are brought into contact with a stepped portion, the control rod is rotated to fit the lateral protuberances into the lateral holes. In this way, the control rod is coupled to the index tube of the control rod drive.

42927 Power distribution control device. Maruyama, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-66192/A/. 1 Dec 1975. 3p. (In Japanese).

A method to permit optimum power distribution control to be automatically carried out by considering a power increase at the tip of a control rod and a change in power with respect to time accompanying the operation of the control rod is described. The control rod is disposed such that it can be smoothly moved along the outer side of a duct or the like accommodating a power detector, and the control rod is driven in relation to the measured value obtained by this detector. More particularly, the power distribution measured by the power detector is sent to a power monitor where it is compared with a reference value. Meanwhile, the measured power distribution is stored in a memory, and from the memorized value and prevailing power distribution a control rod depth indicator forecasts the power distribution at an instant several seconds afterwards and determines the optimum depth of the control rod. Further, a control rod speed change indicator is provided to obtain the change in power with respect to time from the aforementioned memorized value and prevailing power distribution for varying the insertion speed of the control rod.

42928 Analog type control rod position indicator. Masuda, Y. (to Mitsubishi Electric Corp., Tokyo (Japan)). Japanese Patent 1977-66191/A/. 27 Nov 1975. 3p. (In Japanese).

A method to increase the precision of detection and indication of control rod position by compensating for changes in detector output accompanying changes in the temperature of the coolant is described. In a primary side circuit consisting of a constant voltage source, a detector primary winding current limiting resistor and a detector primary winding, a temperature sensor element such as a thermocouple for detecting the temperature within the reactor and a resistance correction circuit for varying the resistance of the temperature detection circuit and current limiting resistor are provided. With this construction, varying the resistance of the current limiting resistor according to the reactor temperature compensates for the change in output due to a change in permeability of the control rod drive shaft accompanying the temperature change within the reactor.

42929 Control rod for nuclear reactors. Yamamoto, Y.; Nomata, T. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-66190/A/. 27 Nov 1975. 4p. (In Japanese).

A method to arrange it such that when a control rod is withdrawn, the change in power from fuel rods near the control rod is substantially the same as the change in power from fuel rods

located at positions remote from the control rod is described. The effective surface area ratio or effective density of a neutron absorbent is reduced toward the central axis. For example, the pitch of the individual control rods is made small at positions remote from the axis of the control rod support shaft such that adjacent control rods are in contact with one another, and is made greater toward the axis of the support shaft.

42930 Reactor control rod. Ueda, M.; Watanabe, S.; Sakurada, K.; Magara, S.; Yanagisawa, S. (to Nippon Atomic Industry Group Co. Ltd., Tokyo). Japanese Patent 1977-63593/A/. 19 Nov 1975. 5p. (In Japanese).

A method to avoid a rapid decrease in reactivity worths of a control rod even if a void occurs is described. In order that a neutron absorber encased in an absorbing rod forming a control rod used in a BWR type reactor or the like, a worked portion (ball) for preventing movement of the neutron absorber is provided in a predetermined position of the absorbing rod in predetermined spaced relation, said worked portion being positioned away 10% of said spacing along the length of the absorbing rod so as not to overlap with another worked portion of an adjacent absorbing rod.

42931 Method of controlling power-up in a reactor. Hayashi, H.; Watari, Y.; Masuda, H.; Kanato, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-60396/A/. 12 Nov 1975. 4p. (In Japanese).

A method to remove a liquid poison contained in heavy water within a reactor vessel, after a control rod has been removed from the core so as to assume a level less than rated power and so that power-up speed may be controlled to a degree that the fuel rod will not be deformed and failed is described. In a method of controlling power-up in a reactor wherein power control may be effected by a solid control rod and liquid poison, the poison is fed from a poison dessolving tower to a heavy water tank, and the heavy water containing the poison is fed into a reactor vessel. Next, a control rod is withdrawn by means of a drive mechanism in a region where power of the fuel assembly is sufficiently low, such as less than 50% of rated power. Thereafter, a part of heavy water circulated between the reactor vessel and the heavy water tank is introduced into the poison removing tower from the bypass line, and the poison in the heavy water is removed to be circulated into the heavy water tank.

42932 Cask for receiving control rod drives. Saijo, T.; Sato, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-60397/A/. 12 Nov 1975. 5p. (In Japanese).

A method to position a gate valve between an upper receiving vessel and a lower receiving vessel of a cask so that it may be used disconnecting the upper receiving vessel when necessary to efficiently perform maintenance and repair work of the upper portion of a control rod drive is described. A lower receiving vessel whose periphery is surrounded by a shield and an upper receiving vessel whose periphery has no shield are separably mounted so that when the respective receiving vessels are separated, a gate valve for sealing the upper receiving vessel is mounted on the upper receiving vessel. When the upper receiving vessel is withdrawn from the reactor for purposes of maintenance and repair, a sleeve is mounted between the structure and a pit cover, and a bed incorporating therein a fixed valve is mounted. Next, the upper receiving vessel provided with the gate valve and a winch means are separated from the lower part and connected onto the bed, and both the valves are opened to remove the upper receiving vessel from the reactor so that it may be carried into a maintenance room for maintenance and repair.

42933 Power control device of reactor. Sato, T.; Watanabe, T.; Kaihara, A. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57496/A/. 7 Nov 1975. 7p. (In Japanese).

A method to control the reactor power to an intended value by operating a plurality of control rods automatically up to a goal position while maintaining a predetermined difference in inserting position is described. A plurality of control rods are separately driven through a ball screw by means of a stepping motor. Meanwhile, the difference between the output of the reactor power detector and the preset value is detected, and this output signal and the output of the control rod position detector are used to select and operate the control rods. At this time, depending upon the polarity of the difference, the control rod inserted to the greatest extent is actuated when the reactor power is insufficient, while the control rod withdrawn to the greatest extent is actuated when the reactor power is excessive.

42934 Feedwater control system for atomic power plant. Yanai, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57494/A/. 7 Nov 1975. 4p. (In Japanese).

A method to permit continuous operation of a reactor even when the feedwater control system functions abnormally is described. The entire control system is divided into a main portion essential for control and a portion which may be rendered into an off-line for a short period of time at the time of an emergency. Duplication is effected for the former, while parallel conversion is effected for the latter. In this way, off-line treatment by the detection of abnormal phenomenon due to signal imbalance is permitted in order to block a break down in the analog control system.

42935 Control rod cooling mechanism. Sasaki, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57497/A/. 7 Nov 1975. 3p. (In Japanese).

A method to facilitate the inspection and maintenance of control rods and control rod drives is described. A control rod inner tube is provided to penetrate a reactor core section within a calandria tank, and the upper end of the tube is provided with a control rod drives. A control rod is moved vertically within the tube by means of a wire rope. Meanwhile, part of a coolant circulation path passes through the outer portion of the calandria tank and connects portion of the control rod guide tube below the core section with portion of the control rod guide tube above the core section. With this construction, it is possible to perfectly separate the heavy water region and helium space within the tank and the interior of the control rod guide tube. Thus, there is no possibility of emission of radioactive substances through the guide tube even by removing the control rod drives.

42936 Vapor temperature control device for fast breeder reactor plant. Morimoto, H.; Fujiwara, T. (to Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). Japanese Patent 1977-57495/A/. 4 Nov 1975. 4p. (In Japanese).

A method to permit the temperature control system of a fast breeder reactor to efficiently control the fluid temperature at the outlet of the heated side is described. A bypass system from the outlet of a secondary system sodium pump to the sodium inlet side of a re-heater is provided, and a flow control valve is provided at an intermediate point in the bypass system. Meanwhile, the control system comprises a system for moving the control rods by means of a subtractor for comparing the output of a vapor temperature detector at the outlet of an over-heater and the output of a temperature setter and a subtractor for producing the set value of the temperature at the outlet of the reactor through a proportional integrator-differentiator from the output of said first-mentioned subtractor and a system for moving a bypass flow control valve by operating said proportional integrator-differentiator controller through a subtractor for comparing the output of the re-heater and the output of the temperature setter.

42937 Reactor control rod. Shirakawa, T.; Otsuji, N. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-54893/A/. 29 Oct 1975. 3p. (In Japanese).

A method to provide a BWR type reactor of excellent control performance, in which a control rod using a powdery neutron absorber as poison does not experience settling of poison even upon repetition of sudden withdrawal operation is described. A control rod is formed by accommodating a plurality of small containers, which are filled with a powdery neutron absorber for preventing the settling of said absorber, in a tube in a row extending in the axial direction of the tube and closing the upper and lower ends of the tube with respective end plugs. Accordingly even if sudden insertion and withdrawal operations are repeated there is no possibility of collection of poison in one place and thus of there are no regions where the control performance suffers a sharp reduction.

42938 Method of controlling power of a heavy water reactor. Masuda, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-52089/A/. 22 Oct 1975. 6p. (In Japanese).

A method to adjust a level of heavy water in a region of reflection body to control power in a heavy water reactor is described. The interior of a core tank filled with heavy water is divided by a partition into a core heavy water region and a reflection body region formed by surrounding the core heavy water region, and a level of heavy water within the reflection body region is adjusted to control power. Preferably, it is desirable to communicate the core heavy water region with the reflection body heavy water region at their lower portion, and gas pressure applied to an upper portion within at least one of said regions is adjusted to adjust the level of heavy water within the reflection body heavy water region. Thereby, the heavy water within the reflection body heavy water region may be introduced into the core region, thus requiring no tank which stores heavy water within the reflection body region.

42939 Control rod drives. Wagatsuma, K. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-50499/A/. 21 Oct 1975. 3p. (In Japanese).

A device for driving control rod in a fast breeder, which can improve workability of maintenance thereof is described. An upper guide tube in a transmitting portion between a driving portion and a control rod has its lower end detachably fitted on a plate for supporting a driving mechanism, and the upper end of the guide tube is air-tightly connected to the outer surface of an inflated portion of

the driving portion, after which the inflated portion is pressed by a plate for fixing the driving mechanism, and said fixing plate is secured to a support cylinder by means of bolts. Then, the upper guide tube in the transmitting portion, to which the cover gas in the reactor tends to be adhered, is disengageably held between the driving mechanism supporting plate and the inflated portion in the driving portion to thereby improve the workability of maintenance.

42940 Pressure adjusting apparatus in a reactor. Fukuzaki, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-46294/A/. 11 Oct 1975. 5p. (In Japanese).

A way to combine a means for setting set value of plant data required for monitoring during the pressure adjustment of a reactor by means of operation of control rods, a means for deciding operation of control rods from comparison between present value and set value, and an operating means, thereby relieving work of operator and providing effective operation is described. Measured values of reactor period, reactor water temperature, reactor pressure, opening degree of bypass valve and reactor power are compared with set values at each of monitoring stations in BWR, and removal and insertion commands of control rods are then released. This command is decided in a station for adjusting operation of control rods and control operating signals are released in accordance with removing sequence of control rods imparted by a setting station, whereby the control rods are driven by a control rod drive mechanism, and pressure loss is calculated in a pressure monitoring station by utilization of measured value of main vapor flow rate and the calculated pressure loss is corrected into a proper set value, which is released to a pressure regulator.

42941 Control rod for a reactor. Natori, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-46295/A/. 11 Oct 1975. 3p. (In Japanese).

A method to change arrangement and density of each layer of neutron absorber in the control rod and to render rotation by each layer possible, whereby the neutron absorber may be rotated to readily flatten power distribution is described. Neutron absorbers such as boron and carbide are filled into stainless steel pipes, which are peripherally arranged in a multi-layer fashion. Arrangement and density of the neutron absorber by each layer are changed and rotation by each layer is made possible, whereby surface area of the absorber or the like is changed to flatten power distribution.

42942 System for positioning a control rod drive for a boiling water reactor. Okamoto, N.; Fukumoto, H.; Mizutani, H.; Kitami, T.; Fujimoto, J. (to Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Japanese Patent 1977-44392/A/. 6 Oct 1975. 4p. (In Japanese).

A method to permit the rapid and simple positioning of control rod drives in such case as when withdrawing the drives from the housing and transferring it to the outside of the dry well of the inspection or the like is described. A guide device for placing the control rod drives into the removing it from of a housing through remote operation is provided with a device for rotating a base, a load cell for detecting impact applied to a base, and a device for finely adjusting the vertical movement of the base. The contact between the end of the housing and the end of the drive which results when raising the control rod drives by a vertical movement fine control device, is detected by the load cell. When defective positioning takes place, the control rod drives are correctly positioned at the opening of the housing by the device for rotating the base.

42943 Control rod assembly. Matsushima, H.; Kato, Y.; Tsutsumi, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-41793/A/. 27 Sep 1975. 4p. (In Japanese).

A method to quickly shut down the reactor by permitting quick insertion of the control rod into the reactor core in a short period of time is described. The wall of a guide tube into which a control rod is inserted is provided with through holes. Thus, when the control rod is inserted into the guide tube by momentarily inserting compressed rare gas at the time of emergency shut-down of a fast reactor, sodium below the control rod in the guide tube flows out through the aforementioned through holes. Consequently, the control rod can be quickly inserted.

42944 Replacing device of control rod drives. Imada, T. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-29596/A/. 29 Aug 1975. 5p. (In Japanese).

A method to permit replacement of the control rod drives of a boiling water type nuclear reactor to be carried out by a small number of personnel is described. A wagon provided with a beam supporting a control rod drives support base and operating cylinder for vertical movement and swinging movement is provided on a platform disposed within a cylindrical chamber in a lower part of a nuclear reactor. The beam is provided with a cylinder means. The piston of the cylinder means is adapted to extend through an opening of a support and assume a position in contact with the tip surface of the control rod drives provided within a pressure vessel.

42945 Improvements in or relating to a method of operating a nuclear reactor which maintains a substantially constant axial power distribution profile which changes with load. Morita, T. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Australian Patent 75/83,034/A/. 15 Jul 1975. 40p.

The invention provides an improved procedure for operating a nuclear reactor that provides substantially symmetric axial xenon distribution during reactor operation including load follow. The desired xenon distribution is accomplished by maintaining a relatively uniform axial power distribution during load follow manoeuvrers, which minimizes total peaking factors and thus avoids power penalties. Furthermore, operating within the specified limits prescribed by the steps of this invention simplifies nuclear analysis procedures, minimizes pellet-cladding interaction effects, and reduces the probability of hitting plant alarm limits which can interrupt plant operation.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 43596, 43698

42946 Nuclear power and the public good. Tombs, Sir F. (Electricity Council, London (UK)). *Atom (London);* No. 255, 2-7(Jan 1978).

This paper by the Chairman of the U.K. Electricity Council is an attempt to illustrate the positive contribution of nuclear power to the needs of mankind in wide context, and to set the problems it raises in the context of the hazards of life in general and of industrial processes in particular. It calls for a sustained effort to bring to the notice of the public a balanced view on the vital position of nuclear power in future energy strategy.

42947 Energy - environment - economy. Pt. 1. Conditions of living of the expanding world population. Hoecker, K.H. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). *Atomwirtsch., Atomtech.;* **22**: No. 10, ang p. 2-3(Oct 1977). (In German).

From Energy policies forum of the Landesregierung and the Universitaet Stuttgart; Stuttgart, Germany, F.R. (9 - 12 May 1977).

In the first part of his lecture, which places the nuclear controversy in the context of large systems and their interactions, the author discusses the relevance of these systems with regard to the conditions of living of the expanding world population as well as the attitude of the public.

42948 Potential effects of nuclear installations on the physical and human environments. Volders, R. (Hydro-Quebec, Montreal (Canada)). pp 17 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session II, Paper 2. Montreal, Canada; Ecole Polytechnique ([nd]). (In French)

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

Thermal effluents from nuclear power plants have some aquatic and atmospheric effects. In aquatic ecosystems, sharp changes in temperature are more disrupting than the small increases in temperature prevailing in Canadian conditions. The rejected heat must be utilized in the long term, probably for district or process heat. Radioactive effluents are well within international guidelines but the public conception and imperfect scientific understanding of chronic low dose irradiation effects are a severe hindrance to nuclear power proliferation. Nuclear power has non-radiological human effects due to its high technological nature, demand for services, skilled labor, and capital, and preference for sparcely populated sites.

SITING

REFER ALSO TO CITATION(S) 43096

42949 (PB—275351) Impact of offshore nuclear generating stations on recreational behavior at adjacent coastal sites. Technical report. Baker, E.J.; Moss, D.J.; West, S.G.; Weyant, J.K. (Florida State Univ., Tallahassee (USA). Florida Resources and Environmental Analysis Center). Dec 1977. Contract AT(49-24)-0320. 146p. NTIS PC A07/MF A01.

A multi-faceted investigation was undertaken to project the impact of offshore nuclear power plants on beach visitation at adjacent beaches. 1. Related literature was reviewed concerning human adjustment to natural hazards, risk-taking behavior, and public attitudes toward nuclear power. 2. Approximately 2400 people were interviewed at beaches in three states with respect to: (a) intended avoidance of beaches near a hypothetical floating nuclear plant (FNP), (b) relative importance of proximity to a FNP, when compared to other beach attributes, (c) onshore-offshore preference

for coastal nuclear plant location, (d) behavioral impact of NRC licensing of FNP's, (e) relative tourism impact of coastal nuclear plant compared to coastal coal-fired plant, (f) public concerns about nuclear safety, (g) public attitudes toward alternative energy sources, (h) public confidence in sources of information about nuclear power, (i) visual impact of a FNP, and (j) knowledge about nuclear power. 3. Four beach areas near currently operating coastal nuclear power plants were studied to assess impacts on tourism resulting from plant construction. Data suggest that proximity of a FNP is less important than other beach attributes in determining beach attractiveness, probably no more than (and perhaps less than) 5% to 10% of current beach patrons would avoid a beach after FNP siting three miles directly offshore, and impact of a FNP would decrease exponentially as distance away increased.

42950 Arrangement plan in adjacent area and subsidy. Sasao, H. (Nihon Univ., Narashino, Chiba. Coll. of Industrial Technology). *Genshiryoku Kogyo;* **23**: No. 7, 16-20(Jul 1977). (In Japanese).

Questions whether the three laws for developing power resources have fulfilled their function for making the agreement with inhabitants, and the direction for strengthening the measures are discussed. The first part deals with the location problem of power plants. The most important reason why inhabitants refuse the public acceptance for nuclear power plants is the fear for safety and the hitherto nuclear national policy. Therefore, the adjacent area arrangement measures must be completed. The second part deals with the three laws for developing power resources now in force and the problems thereof. The tax for promoting the development of power resources amounts to about 33,200 million yen in 1977. The subsidy granted to the adjacent area for locating a power plant is for example about 3,500 million yen for a plant of 1 million kW output. Attentions must be paid to (1) the object facilities for the granted subsidy, (2) the time and term of granting subsidy, and (3) the fundamental plan for the adjacent area arrangement. The third part deals with the features of adjacent area arrangement for locating a nuclear power plant. The fourth part deals with the author's opinion for promoting such measures of the above described fundamental plan. The fundamental plan must be composed as follows: (1) the assessment of community, (2) the arrangement plan based on the direction of developing the economical society of the area, and (3) so called physical facility arrangement plan.

42951 Community attitudes toward a proposed nuclear power generating facility as a function of expected outcomes. Sundstrom, E. (Univ. of Tennessee, Knoxville); Lounsbury, J.W.; Schuller, C.R.; Fowler, J.R.; Mattingly, T.J. Jr. *J. Commuity Psychol.;* **5**: 199-208(1977).

The relationship between attitudes toward a proposed nuclear power generating facility and the outcomes expected to accompany it are examined. In a survey of 350 residents of a small rural community, approximately 2/3 expressed favorable attitudes toward the proposed nuclear plant. A principal components factor analysis of the anticipated likelihoods of outcomes of the plant revealed five factors: hazards, economic growth, lower costs, social disruption, and community visibility. Using these factors as predictors, a simple multiple regression equation accounted for 52% of the variation in attitudes toward the plant. The strongest predictor was the perceived likelihood of hazards. These findings are discussed in terms of the relationship between attitudes and expectations, and in relation to decisions regarding public policy.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 42339, 42343, 43584

42952 Tsuruga Power Station new rad waste treatment system. Kurihara, Y.; Kobayashi, Y. (Japan Atomic Power Co., Tsuruga, Fukui. Tsuruga Power Station). *Karyoku Genshiryoku Hatsuden;* **28**: No. 4, 355-363(Apr 1977). (In Japanese).

Tsuruga Power Station is a BWR type nuclear power plant, and after about six and a half years operation since the commissioning in March 1970, the additional rad waste treatment system became necessary, and it was decided to construct it. The content of this additional system is explained as well as the initial one in this paper. The main new system is composed of electro magnetic filter, ultra filter, the concentrating equipment for floor drain, etc. in the liquid rad waste treatment system, and filter sludge storage tank, asphalt solidification facility, incinerator, solid rad waste storage and relating air conditioning system. The philosophy, basic planning, and time schedule of this additional works, many new equipments and their specifications, and this new rad waste treatment system are reviewed and described. Decrease of rad waste volume and effective and safe storage management are expected by adding this new rad waste treatment system in this plant.

42953 Who controls low-level radioactive wastes. Poulin, J.W. *Environ. Aff.;* **6**: No. 2, 201-225(1977).

The Atomic Energy Commission (AEC) and the utility industry have committed major national resources to the development of nuclear energy. Supporters of this policy view nuclear power as a source of cheap, clean, and inexhaustible energy, and assert that scientists have reduced the risk of a serious nuclear accident to a tolerable level. Critics argue that the AEC has exaggerated the benefits of nuclear power and understated the risks without informing the public of the dangers involved. The major concern of both proponents and critics has been high-level radioactive wastes which remain intensely radioactive for thousands of years. Low-level wastes, in contrast, have a relatively short life span, and can be dispersed into the air and water with less danger. Yet, the introduction of low-level wastes into the environment also poses potentially serious problems. Proponents of nuclear power have decided that some exposure to low-level radioactive wastes is warranted for the development of nuclear energy, even though scientists do not know the long-term effects of low-level radiation exposure and have not established the threshold for harmful radiation. The lack of evidence on the effects of low-level dosages renders this decision a value judgment. Therefore, it becomes important who has the responsibility for formulating the standards for exposure to the public health and environment.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 43715

42954 Koeberg prawns, sir... Champion, H. (Fisheries Development Corporation of South Africa Limited, Cape Town (South Africa)). *Nucl. Act.;* No. 18, 9-13(Jan 1978).

Aquaculture as a profitable off-shoot of nuclear and conventional power production is being investigated scientifically by the Fisheries Development Corporation at its prawns research centre, sited on South Africa's east coast.

42955 Waste heat utilization of nuclear power stations. Hofmann, R. (Wissenschaftlicher Adjunkt, Amt fuer Wissenschaft und Forschung, Bern, Switzerland). *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 16, 834-838(13 Aug 1977). (In German).

From SEV/VSE meeting on heat utilization of nuclear power stations; Zurich, Switzerland (28 Jun 1977).

Project studies and experiments in reactor waste heat utilization carried out and currently in progress in Switzerland are discussed. The economy of reactor waste heat utilization is shown to be to a large extent dependent upon the fuel/electricity price ratio for fossil fuels, but it also relies on the capability to carry out the necessary research and development work, in time, in very diverse areas such as development of thermal pumps and the use of heating in agriculture and horticulture.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 42761, 42984, 43006

42956 (AAEC/E—418) **Analysis of power transients observed in the SPERT-2 D_2O moderated close packed core.** Connolly, J.W.; Harrington, B.V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1977. 24p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The power transient behaviour of the very under-moderated SPERT-2 core B18/68 is analysed. The experimental conditions included core pressurisation and forced coolant flow. Generally good agreement is obtained between measured and calculated data.

42957 (JAERI-M—7105) **Standard water capsule and instrumentation for NSRR experiments.** Yamazaki, T.; Kikuchi, T.; Toyokawa, S.; Uno, H.; Yachi, S. (Japan Atomic Energy Research Inst., Tokyo). Jun 1977. 77p. (In Japanese). Dep. NTIS (US Sales Only), PC A05/MF A01.

The standard water capsule and the instrumentation, and instructions thereon, in NSRR experiments are described. Over 100 in-pile experiments on the behavior of nuclear fuel under reactivity-initiated accident conditions have been performed in NSRR experiments. Much useful results were obtained with the capsules and instrumentations. Among the various kinds of instrumentations, the measuring systems of fuel surface temperature, water temperature, internal pressure of fuel cladding, pressure near to fuel cladding and water column motion operated satisfactorily. Efforts will continue in the future to improve or develop the measuring techniques for water hammer pressure, vapour phase in water and fuel meat temperature.

42958 (KURRI-TR—150) **Safety and interlock system of Kyoto University Critical Assembly.** Tsujimoto, H.; Nakamura, H.; Kobayashi, T.; Shibata, T. (Kyoto Univ., Kumatori, Osaka (Japan). Re-

search Reactor Inst.). 31 Jan 1977. 32p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

KUCA (Kyoto University Critical Assembly) is an entirely new type of critical facility which is composed of three independent highly enriched uranium cores, two with solid moderators and the other with a light water moderator. These three cores share many common facilities such as control rod drive mechanism, instrumentation system, and various experimental facilities. To secure safety and smooth operation of this multi-core system, a safety and interlock system was developed based on the ten years experiences in design, construction, and operation of research reactors at the Research Reactor Institute of Kyoto University. The first critical experiment with KUCA was performed in August 1974. Since then, this safety and interlock system have served as the nucleus of the network of KUCA. This document provides with the basic concept of the safety and interlock system together with various experiences in its construction and operation. Safety logics and system flow charts in various operational procedures are explained with many figures and tables.

42959 (LTR—141-72) **LOFT advanced densitometer ARA III/L1-4 preparatory tests.** Wood, D.B. (Idaho National Engineering Lab., Idaho Falls (USA)). 3 Mar 1978. Contract EY-76-C-07-1570. 37p. Dep. NTIS, PC A03/MF A01.

A report on the LOFT advanced densitometer lab testing that was conducted at ARA-3 in preparation for the non-nuclear L1-4 blowdown at LOFT is presented. The densitometer uses a pulse height analysis method for determining PWR coolant fluid chordal average density. The average density of the coolant fluid along the Cs-137 gamma beam path is determined by measuring the uncollided flux count rate in a Cs-137 photopeak and knowing the LOFT primary coolant hot leg piping geometry. This is an application of a gamma densitometer technique which processes discrete pulses and with no pulse pile-up or integration taking place. Time sampling of the piping and fluid attenuated Cs-137 spectrum provides the data which is related to the changing coolant fluid density as a function of time.

42960 **Neutron radiography facility on the IRT-2000 reactor.** Khadduri, I.Y. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.). *Nucl. Instrum. Methods;* **147**: No. 1, 115-118(15 Nov 1977).

From 9. international conference on solid state nuclear track detectors; Neuherberg, Germany, F.R. (Oct 1976).

A neutron radiography facility has been constructed on the thermal neutron channel of the IRT-2000 reactor. A collimated thermal neutron beam exposure area of 10 cm diameter is obtained with an L/D ratio of 48.8. The film used is cellulose nitrate coated with lithium tetraborate which is insensitive to gamma and beta radiation. Some pictures with good contrast and resolution have been obtained. Pictures of parts of an IRT-2000 reactor fuel pin have also been recorded.

42961 **Determination of neutron spectrum in SR-O reactor by activation technique.** Hogel, J.; Vespalec, R. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). *Jad. Energ.;* **23**: No. 4, 129-131(Apr 1977). (In Czech).

Activation detectors were irradiated in the neutron trap of the SR-O reactor core. Foils in a special case lined with cadmium sheet 1 mm in thickness for resonance detectors and 0.5 mm in thickness for threshold detectors were placed in a channel 21 mm in dia. The diameter of foils and pills was 17 mm and their thickness ranged within 0.1 and 3 mm. Activity was measured with a scintillation probe with a NaI(Tl) crystal 45 mm in dia. and 50 mm in length or with a Ge(Li) detector with an active volume of 76 cm^3. The obtained activity values per 1 nucleus of target material were used as input data for spectrum calculation using the COCKROACH, RDMM and SAND II codes. Fast neutron spectra obtained using the above codes are graphically shown. Also shown is the neutron spectrum in the neutron trap. The experiments show that a small set of activation detectors may be used for determining a wide energy range spectrum.

42962 **Anticorrosional protection in nuclear power station objects.** Czarnocki, A.; Kwiatkowski, A. (Osrodek Badawczo-Rozwojowy Budownictwa Elektrowni OBREL, Warsaw (Poland)). *Inz. Budownictwo;* **33**: No. 11, 428-430(Nov 1976). (In Polish).

The distribution and qualities of chemical protection and demands concerning preparation of the bottom for protecting coats in nuclear power station objects are discussed. The solutions of protections applied abroad and in the objects of "MARIA" reactor are presented.

42963 **Polarized neutron intensive beam on a vertical reactor channel.** Erozolimskii, B.G.; Mostovoi, Yu.A.; Obinyakov, B.A.; Petushkov, S.A.; Fedunin, V.P.; Khakhan, O.V.; Chernyshevich, V.N. *Prib. Tekh. Eksp.;* No. 6, 39-42(1976). (In Russian).

A vertical neutron channel with a water gate for beam shutoff and a light-grasp thermal neutron polarizer is described. Its principal characteristics are given. The lower part of the channel is arranged in a water-beryllium "trap" located in the centre of the reactor core. A beam of polarized neutrons is led out with the total flux of 1.5 x 10^9 neutron/sec and polarization not less than 75%.

42964 **Embedded type high-flux reactor.** Umeda, I. (to Nippon Kokan K.K., Tokyo). Japanese Patent 1977-53198/A/. 28 Oct 1975. 5p. (In Japanese).

A method to integrally embed a primary system having a radioactivity into concrete thereby preventing an occurrence of accident resulting from a failure of machineries in the primary system is described. The primary system of a high-flux reactor, which comprises a reactor container, a main heat exchanger, a main cooling system, a pressure control, deairing system, and a primary purifying system, is integrally embedded into concrete.

42965 **Nuclear fuel apparatus and a two-region core reactor using the apparatus.** Umeda, I. (to Nippon Kokan K.K., Tokyo). Japanese Patent 1977-53196/A/. 27 Oct 1975. 4p. (In Japanese).

A method is described to provide a high-flux reactor in which distribution of fast neutron flux and distribution of heat generation of fuel in order to burn fuel as even as possible over the entire core to minimize the coefficient of hot spot to increase the thermal characteristic of fuel for purpose of extending the service life of core. A portion containing no nuclear fuel is provided in the midst in a vertical direction of fuel region for fuel plates or rods in the length that may obtain the maximum thermal neutron peak. These are longitudinally arranged in two sets to constitute a two-region core.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 42991

42966 (N—78-10861) **Analysis of the Gas Core Actinide Transmutation Reactor (GCATR). Semiannual report.** Clement, J.D.; Rust, J.H. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1 Sep 1977. 142p. (NASA-CR—155221). NTIS PC A07/MF A01.

Design power plant studies were carried out for two applications of the plasma core reactor: (1) As a breeder reactor, (2) As a reactor able to transmute actinides effectively. In addition to the above applications the reactor produced electrical power with a high efficiency. A reactor subsystem was designed for each of the two applications. For the breeder reactor, neutronics calculations were carried out for a U-233 plasma core with a molten salt breeding blanket. A reactor was designed with a low critical mass (less than a few hundred kilograms U-233) and a breeding ratio of 1.01. The plasma core actinide transmutation reactor was designed to transmute the nuclear waste from conventional LWR's. The spent fuel is reprocessed during which 100% of Np, Am, Cm, and higher actinides are separated from the other components. These actinides are then manufactured as oxides into zirconium clad fuel rods and charged as fuel assemblies in the reflector region of the plasma core actinide transmutation reactor. In the equilibrium cycle, about 7% of the actinides are directly fissioned away, while about 31% are removed by reprocessing.

42967 (UNI-NUSAR—293(Rev.1)) **Thermal analysis for KE-Basin fuel storage under complete cooling water loss conditions.** Krajicek, J.E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 1975. Contract EY-76-C-06-1857. 27p. Dep. NTIS, MF A01.

Portions of document are illegible.

This document reports the results of a study performed to determine the maximum fuel temperatures which would result from complete loss of cooling water to irradiated fuel stored in the KE-Storage Basin. The analyses will be used to support the storage of N Reactor fuel in KE-Basin. The determination of the probability of a complete water loss accident and the evaluation of the radiological consequences of the event are outside the scope of this study.

PROPULSION REACTORS

42968 (PB—272711) **Development of accident event trees and evaluation of safety system failure modes for the nuclear Ultra Large Crude Carrier (ULCC). Final report.** Coffey, R.S.; Goodwin, E.F.; Lewe, C.K.; Maltese, J.G.; Pyatt, D.W. (NUS Corp., Rockville, Md. (USA)). Feb 1977. Contract MA-T-38160. 167p. (NUS—1845). NTIS PC A08/MF A01.

Various ship accidents which have the potential of causing damage to the nuclear power systems of the nuclear powered Ultra

Large Crude Carrier (ULCC) are identified. For each ship accident, an event tree is developed which shows the possible causal relationship between ship accident and derangement of nuclear safety-related systems. System state diagrams are developed which define the degree of availability of each safety-related system. As an example of the use of the methodology, availability state tables are derived for each safety-related system for all potential results of a collision accident. Further, an analytic set of probability equations are derived relating the probability of loss-of-function, either partial or complete, of the low pressure safety injection system to the various consequences of a collision.

42969 Radiation streaming of N.S. MUTSU and its repair plan. Miyakoshi, J.; Osanai, M.; Tsubosaka, A. (Japan Nuclear Ship Development Agency, Tokyo); Miyasaka, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki). *Atomkernenergie;* **30**: No. 4, 265-268(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

During the period September 1974-February 1975, a detailed investigation was undertaken on the neutron streaming from reactor shielding observed on board the N.S. MUTSU. Tests were carried out with the reactor at partial power (83 kWth = 0.23%) of full rating, under which condition the radiation distribution was measured in the space outside the primary and secondary shields, for the purpose of determining the cause of the abnormal radiation observed during the preceding low-power tests. The results derived from these measurements, as well as analytical calculations, indicated that the abnormal radiation resulted from neutrons leaking out through the gap that existed between the pressure vessel and the primary shield. Based on the foregoing results, a plan has been adopted for modifying the shielding arrangement, by adding new shielding to close the gap referred to above and further supplementing and modifying both the upper and lower parts of the reactor shielding structure.

42970 Mock-up experiment and analysis for the primary shield of the N.S. MUTSU. Miyasaka, S.; Asaoka, T.; Taji, Y.; Ise, T.; Koyama, K.; Tsutsui, T.; Takeuchi, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki); Fuse, T.; Miura, T.; Yamaji, Y. (Ship Research Inst., Tokai, Ibaraki (Japan). Tokai Branch). *Atomkernenergie;* **30**: No. 4, 269-274(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

A series of shielding mock-up experiments was performed at JRR-4, a swimming pool type reactor, of Japan Atomic Energy Research Institute (JAERI) to obtain the necessary experimental data and the sufficiently accurate method of calculation adopted for the modification of the MUTSU primary shield. Analyses for the experiments were carried out by using of the Ssub(n) codes, ANISN and TWOTRAN. The two dimensional calculations were performed with the P_1-S_8 approximation. The neutron streaming through the annular gap between the pressure vessel and the primary shield has been confirmed to be estimated from the present method of calculation. The agreement between the calculated and the measured values is generally in about a factor of 2 to 4.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 43585

42971 (AAEC/E—416) **Sensitivity study of the heat transfer processes involved in a hot-leg rupture in a pressurized water-cooled system.** Green, W.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1977. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A series of computer experiments was performed, using the reactor thermal analysis code THETA1-B, to ascertain the significance and relative importance of the various heat transfer processes in relation to the prediction of maximum surface temperatures for: (i) the fuel cladding during the blowdown phase of a loss of coolant accident (LOCA) for a hot-leg rupture in a pressurised water reactor system; and (ii) an electrically heated tube of a simple water-cooled test assembly, subjected to a corresponding hot-leg blowdown, for which experimental results have been published. The significance of several factors was considered, including the choice of heat transfer correlation for a particular heat transfer regime, and inlet coolant flow conditions. For both cases the predicted maximum surface temperature was sensitive to a number of factors, including choice of heat transfer correlations for (i) critical heat flux, (ii) flow boiling transition region and, in particular, (iii) stable film boiling.

42972 (AD-A—047831) **Significance of warm prestress to crack initiation during thermal shock. Interim report.** Loss, F.J.; Gray, R.A. Jr.; Hawthorne, J.R. (Naval Research Lab., Washington, D.C. (USA)). 29 Sep 1977. Contract AT(49-24)-0207. 26p. (NRL/NUREG—8165). NTIS PC A03/MF A01.

During a loss of coolant accident (LOCA) followed by operation of the emergency core cooling system, the inside wall of a nuclear pressure vessel is subjected to high thermal stresses that can cause extension of a preexisting flaw. The crack-tip stress intensity factor K(I) may achieve its maximum value early in the transient, but the critical level for crack initiation K(Ic) may not be reached until minutes later, when the loading has decreased from its peak. This phenomemon, termed warm prestress (WPS), can preclude crack extension when K(I) equals or exceeds K(IC). In an experimental program, employing three-point bend specimens, it was demonstrated that warm prestress acts to elevate the 'effective' K(Ic) of the material at the crack tip. This elevation is not uniform; it depends on the WPS level, the degree of unloading, and the increment between the temperature of WPS and the failure temperature. However, WPS can result in an effective elevation in K(Ic) to the WPS level, so that shallow cracks are arrested and deeper ones not extended. The experiments also demonstrated that failure never occurs during the unloading portion of the simulated LOCA path. Factoring WPS into an elastic analysis of crack extension during an LOCA results in predicted crack extension of greatly reduced proportions such that complete penetration of the wall does not occur. The experiments show that the phenomenon of warm prestress should be considered in predictions of reactor vessel integrity, and that this phenomenon may form a key element upon which to base assurance of vessel integrity during an LOCA. (Author)

42973 (AECL—5856) **Heavy-water-moderated pressure-tube reactor safety.** Pease, L.; Sawai, S. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Aug 1977. 78p. (CONF-761194—1). Dep. NTIS (US Sales Only), PC A05/MF A01.

From Conference on world nuclear power; Washington, DC, USA (Nov 1976).

Several countries have heavy-water-moderated, pressure-tube reactors either in commercial operation or in late prototype stages. The supporting safety research and development includes such areas as the thermohydraulics of circuit depressurization, heat transfer from the fuel, heat rejection to the moderator from dry fuel, fuel and sheath behaviour, and fuel channel integrity. A brief review is presented of the work done in Canada, Great Britain, Italy and Japan, and some of the experimental tests underlaying the methods of accident analysis are described. The reactors have safety systems which, in the event of an accident, are able to shut down the reactor, keep the fuel cooled, and contain any released radioactivity. We summarize the characteristics of these safety systems (shutdown, emergency core cooling, and containment) in the various reactors, and discuss other reactor characteristics which either prevent accidents or reduce their potential demand on the safety systems.

42974 (ANL—77-47) **One-dimensional drift-flux model and constitutive equations for relative motion between phases in various two-phase flow regimes.** Ishii, M. (Argonne National Lab., Ill. (USA)). Oct 1977. Contract W-31-109-ENG-38. 62p. Dep. NTIS, PC A05/MF A01.

In view of the practical importance of the drift-flux model for two-phase flow analysis in general and in the analysis of nuclear-reactor transients and accidents in particular, the kinematic constitutive equation for the drift velocity has been studied for various two-phase flow regimes. The constitutive equation that specifies the relative motion between phases in the drift-flux model has been derived by taking into account the interfacial geometry, the body-force field, shear stresses, and the interfacial momentum transfer, since these macroscopic effects govern the relative velocity between phases. A comparison of the model with various experimental data over various flow regimes and a wide range of flow parameters shows a satisfactory agreement.

42975 (ATR—77(7652-01)-1) **Systems management support for ERCDC study of undergrounding and berm containment. Interim report. Preliminary program assessment and follow-on program development.** (Aerospace Corp., El Segundo, Calif. (USA). Energy and Transportation Div.). Aug 1977. 360p. Aerospace Corp., El Segundo, CA.

Interim results of a study being conducted with respect to the technological aspects of the costs and benefits of underground nuclear power plant construction in direct support of the California Energy Commission's legislative mandate in this area are presented. The program was directed towards problem scoping, methodology evaluation, program definition and planning for subsequent, more detailed investigations of underground facility designs and their potential advantages and disadvantages. The material presented describes the results of (a) systems analyses which were conducted to determine logical requirements for determination of those elements of a nuclear power plant which should be constructed underground; (b) bounding estimates of incremental plant costs for a variety of underground concepts; (c) applicable prior experience in underground facility design and construction which could be used to

identify potential sources of strength and weaknessees of underground nuclear power plants; (d) estimates of seismic environments for underground construction in California; (e) preliminary descriptions of underground reactor accident scenarios; (f) bounding estimates of the consequences of such accidents, in terms of comparisons of relative emissions of radioactivity with respect to similar accidents for surface-sited nuclear power plants and (g) results of analyses of several other important technological aspects of the problem. A description is also provided of the program development work performed to provide planning and criteria for subsequent investigations to determine: (a) definitive underground nuclear power plant designs and costs, and (b) estimates of accident consequences in underground nuclear power plants.

42976 (CENPD—172-A) **Plant protection system with integrated automatic test system.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1978. 266p. Combustion Engineering, Inc., Windsor, CT.

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The preliminary design aspects of the new Plant Protection System with Integrated Automatic Test System which Combustion Engineering is presently offering as an alternate to the plant protection system described in the CESSAR System 80 PSAR are described. The new Plant Protection System performs the same functions and utilizes the same trip inputs as the previous system presented in CESSAR System 80 PSAR. The new Plant Protection System is an integration of the Reactor Trip System, Engineered Safety Features Actuation Systems, and Automatic Test System. The review of the new Plant Protection System was focused on those aspects of the design which were different from those of the previous system. The new system, referred to as the Solid State Plant Protection System, consists of bistables, local coincidence logics, initiation logics and automatic test system. The review also included the interfaces between the Solid State Plant Protection System and the measurement channel equipment, core protection calculators, actuation logic and actuation devices. The interface requirements imposed by the Solid State Plant Protection System on the balance of the plant design were also examined to determine if they were consistent with similar requirements found acceptable during the review of the Plant Protection System presented in CESSAR.

42977 (COO—2571-10) **Improvement and verification of fast reactor safety analysis techniques. Progress report, 1 July 1977—30 September 1977.** Barker, D.H.; Wheeler, P.A. (Brigham Young Univ., Provo, Utah (USA). Dept. of Chemical Engineering). 1977. Contract EY-76-S-02-2571. 10p. Dep. NTIS, PC A02/MF A01.

A calorimeter was designed and built to measure reaction power in the range where liquid is boiling. Measurements made with the new calorimeter at a concentration just lower than what would produce boiling (3m) was about 10% lower than those measured using the Precision Calorimeter. A heat loss of about 40% due to a non-adiabatic vessel was determined by comparing the reaction power in solution of the reaction vessel to that of the calorimeter. A closed reaction vessel was designed to observe the effects of pressure (up to 3 atm) on the dispersion height. A preliminary calculation of the theoretical critical superficial vapor velocity was 0.0412 m/sec.

42978 (EPRI-NP—705) **CAT: a computer code for the automated construction of fault trees.** Apostolakis, G.E.; Salem, S.L.; Wu, J.S. (California Univ., Los Angeles (USA)). Mar 1978. 264p. Dep. NTIS, MF A01.

Portions of document are illegible.

A computer code, CAT (Computer Automated Tree, is presented which applies decision table methods to model the behavior of components for systematic construction of fault trees. The decision tables for some commonly encountered mechanical and electrical components are developed; two nuclear subsystems, a Containment Spray Recirculation System and a Consequence Limiting Control System, are analyzed to demonstrate the applications of CAT code.

42979 (EPRI-NP—743) **UC-B Reflood Program: experimental data report. Interim report.** Seban, R.; Grief, R.; Yadigaroglu, G.; Elias, E.; Yu, K.; Abdollahian, D.; Peake, W. (California Univ., Berkeley (USA)). Apr 1978. 264p. Dep. NTIS, PC A12/MF A01.

Experimental results are presented for the quenching of a vertical 0.565 in (14.4 mm) inside diameter vertical tube 12 ft (3.66 m) long by the bottom injection of water at temperatures of about 70°F (21°C) and 150°F (66°C), at rates which gave velocities at the inlet to the tube from 1 to 7 in./sec (25 to 180 mm/sec). The pressure was atmospheric. Constant electrical heat input was used, and the cooling of the tube was from initial equilibrium conditions that gave tube temperatures from 600°F (316°C) to 1400°F (760°C). Thirty-two combinations of initial tube temperature, water velocity, and water temperature were examined, and the results, indicated as a function of the time, include the variation of tube wall temperature, the equivalent height of the water in the tube, the exiting liquid and steam flow rates, and the exiting fluid temperature. Local heat fluxes and apparent heat transfer coefficients in the region above the quench front are also presented.

42980 (EPRI-NP—763) **Pipe stress intensity factors and coupled depressurization and dynamic crack propagation. 1976 Annual report.** Emery, A.F.; Kobayashi, A.S.; Love, W.J. (Washington Univ., Seattle (USA). Dept. of Mechanical Engineering). Apr 1978. 189p. Dep. NTIS, PC A09/MF A01.

This report contains the description of predictive models for the initiation and propagation of cracks in pipes and the numerical results obtained. The initiation of the crack was studied by evaluating stress intensity factors under static conditions for a series of representative flaws. Three-dimensional static stress intensity factors were determined for quarter-elliptical cracks at the corner of a hole in an infinite plate and at the corner of a bore in a rotating disk. Semi-elliptical cracks for plates in bending and in pressurized and thermally stressed hollow cylinders were also evaluated. The stress fields, in the absence of a crack, were used in the "alternating technique" to compute the stress intensity factors along the crack front. Parametric studies were made to assess the effects of crack thickness, the ratio of the major and minor axes of the ellipse and the thickness of the cylinders or plates. These parametric results may be used to predict critical flaw sizes for the initiation of the running crack. The initiation and propagation of axial through cracks in pressurized pipes was studied by using an elastic-plastic finite different shell code coupled with a one-dimensional thermal-hydraulic code which computed the leakage through the crack opening and the depressurization of the fluid in the pipe. The effects of large deflections and different fluid pressure profiles were investigated. The results showed that the crack opening shape is dependent upon the fracture criterion used and upon the average pressure on the crack flaps, but not upon the specific pressure profile. The consideration of large deflections changed the opening size of the crack and through the coupling with the pipe pressures, strongly affected the crack tip speed. However, for equal crack lengths, there was little difference between calculations made for large and small deflection.

42981 (GA-A—14568) **Comparison of three methods for the quantitative analysis of common cause failures.** Fleming, K.N.; Raabe, P.H. (General Atomic Co., San Diego, Calif. (USA)). May 1978. Contract EY-76-C-03-0167-065. 18p. (CONF-780507—14). Dep. NTIS, PC A02/MF A01.

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A comparison is presented of three methods to predict the reliability characteristics of redundant systems subject to independent and common cause failures. Markov models are used to show that the "beta factor" method, developed and used in the HTGR risk assessment study conducted at General Atomic, is theoretically consistent with alternative approaches that are based on the multivariate exponential distribution developed by Marshall and Olkin. Comparative assessments of simple redundant systems based on actual reliability data are used to investigate differences between the "beta factor" method and the "geometric mean" approach used in the Reactor Safety Study.

42982 (GA-A—14922) **HTGR Generic Technology Program: safety, systems and component design and development. Quarterly progress report for the period ending March 31, 1978.** (General Atomic Co., San Diego, Calif. (USA)). Apr 1978. Contract EY-76-C-03-0167-065. 104p. Dep. NTIS, PC A06/MF A01.

The work documented includes HTGR safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs under postulated accident conditions. Also included are the design, analysis, and testing of th PCRV, liner, penetrations, thermal barrier, reactor internals, steam generator, CAHE, and rotating machinery. Design studies and analysis plus experimental procedures and results are discussed and, where appropriate, the data are presented in tables, graphs, and photographs.

42983 (GEFR—00256) **PECS-III: probabilistic evaluation of cladding lifetime in LMFBR fuel pins.** Lovejoy, W.S.; Patel, M.R.; Hoover, D.G.; Krommenhock, F.J. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1977. Contract EY-76-C-03-0893-011. 220p. AT.

Theoretical basis, user instructions, a sample whole-core analysis and program listing for the probabilistic FBR fuel pin structural analysis code PECS-III (Probabilistic Evaluation of Cladding Lifetime) are described. Monte Carlo simulation is used to generate probability distributions for time to failure, cumulative damage fraction and other significant parameters in fuel pin cladding subjected to the fission gas pressure and fuel-cladding mechanical interaction loads under normal operating conditions. Importance sampling is used to reduce the number of Monte Carlo samples required for adequate estimate of the low probability of failures. A multiple regression analysis capability in the code permits correlation between selected input parameters and PECS-generated response pa-

rameters. The code is operational on the Honeywell-6000 and CDC-7600 computers.

42984 (HEDL-TI—75002-22) **FSAR Amendment 22. Addition of response Q130.57 to Supplement 21.** (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1978. Contract EY-76-C-14-2170. 14p. AT.

Additional data on the seismic analysis of FFTF structure is presented in response to an NRC request.

42985 (NUREG/CR—0006) **Steady and transient natural convection with volumetric energy sources in a fluid layer bounded from below by a segment of a sphere. Annual report, July 1976—September 1977.** Min, J.H.; Kulacki, F.A. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Dec 1977. 106p. NTIS $6.50.

An experimental study has been conducted on the steady-state heat transfer and the transient thermal response in an internally heated fluid layer bounded from below by a segment of a sphere. The layer is bounded from above by a rigid, isothermal horizontal surface and from below by a rigid, zero heat-flux surface. The spherical segment has a total polar angle of 60^0, and experimental data have been obtained for layer geometries that range from nearly a spherical segment to a spherical segment with a superposed horizontal layer. Volumetric energy sources within the fluid are produced by Joule heating with alternating current passing between the upper and lower surfaces of the layer.

42986 (ORNL/NUREG/NSIC—147(Rev.)) **Index to Nuclear Safety: a technical progress review by chronology, permuted title, and author. Vol. 11(1)—Vol. 18(6).** Cottrell, W.B.; Klein, A. (Oak Ridge National Lab., Tenn. (USA)). 11 Apr 1978. Contract W-7405-ENG-26. 120p. Dep. NTIS, PC A06/MF A01.

This index to Nuclear Safety covers articles published in Nuclear Safety, Vol. 11, No. 1 (January-February 1970), through Vol. 18, No. 6 (November-December 1977). It is divided into three sections: a chronological list of articles (including abstracts) followed by a permuted-title (KWIC) index and an author index. Nuclear Safety, a bimonthly technical progress review prepared by the Nuclear Safety Information Center (NSIC), covers all safety aspects of nuclear power reactors and associated facilities. Over 450 technical articles published in Nuclear Safety in the last eight years are listed in this index.

42987 (SAN—1011-114) **Study of vertical ground response spectrum shapes.** Werner, S.D.; Ts'ao, H.S. (Agbabian Associates, El Segundo, Calif. (USA)). Aug 1977. Contract EY-76-C-03-1011. 71p. AT.

The report provides the results of an investigation of the effect of different normalizing procedures on the shape of response spectra for vertical earthquake ground motion. Vertical free-field earthquake ground motion records processed at the California Institute of Technology were used for the study. Spectra shape comparisons were made for composite spectra (mean and mean +- sigma) derived from spectra normalized to peak ground acceleration, peak ground velocity, and peak ground displacement, respectively. Spectra shapes were also derived by a three segment method and from natural (i.e., not normalized) spectra. Effects of local geology and local soil conditions on response spectra shapes were also investigated. Vertical spectra were developed for five different damping ratios using the three segment method. The results of the investigation indicate that spectra developed from the statistical analysis of natural ground motion data has two advantages over spectra developed from the statistical analysis of normalized spectra shapes, namely (1) the spectra will not be distorted by the normalizing process; and (2) the probability of exceedance of the composite spectra can be well defined rather than approximated. Comparisons of composite spectra developed from both natural data and from normalized spectra with Regulatory Guide 1.60 procedures indicate that Regulatory Guide 1.60 procedures lead to vertical ground response spectra that are overly conservative. Comparisons of spectra for different local site conditions indicate that the method selected for normalizing the data has an important bearing on the extent to which local site effects appear to influence the spectrum shape.

42988 (SAN—1011-117) **Seismic design verification of LMFBR structures.** (Agbabian Associates, El Segundo, Calif. (USA)). 1 Jul 1977. Contract EY-76-C-03-1011. 119p. TIC $6.50.

The report provides an assessment of the seismic design verification procedures currently used for nuclear power plant structures, a comparison of dynamic test methods available, and conclusions and recommendations for future LMFB structures.

42989 (UCRL—52000-78-2) **Energy and technology review.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1978. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

Separate abstracts were presented for each of the 3 included sections.

42990 (UCRL—52000-78-2, pp 1-8) **Boiling-water reactor safety studies.** Feb 1978.

In Energy and technology review.

The Nuclear Regulatory Commission has funded LLL to study the pressure-suppression containment system of the Mark I class of boiling-water reactors (BWR). In particular, LLL is investigating how this containment system responds to a loss-of-coolant accident (LOCA), a design basis for light-water nuclear reactors. Part of this work is being carried out on the Laboratory's $^1/_5$-scale experimental facility that models the pressure-suppression containment system of the Peachbottom 2 nuclear power plant. LLL is also conducting computer analyses of the way wall flexibility affects LOCA-induced loads in the containment system and of the safety margins in the containment structure. Results from these studies will help the NRC to review future BWR designs and may lead to decisions affecting the continued operation of many existing BWR power plants in the United States.

42991 (UNI—638) **Functional design criteria reactor plant facilities fire protection improvements.** (United Nuclear Industries, Inc., Richland, Wash. (USA)). 2 Dec 1976. Contract EY-76-C-06-1857. 9p. Dep. NTIS, PC A02/MF A01.

The purpose of the design criteria is to functionally describe the required additions to, or modifications of, the existing N-reactor fire protection systems and equipment in order to maintain a high level of fire protection.

42992 (WCAP—9207) **Evaluation of mispositioned ECCS valves.** Hill, R.A.; O'Brien, J.F.; McIntire, D.C.; Barlow, R.T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1977. 82p. Westinghouse Electric Corp., Pittsburgh, PA.

In October of 1975, Westinghouse submitted NS-CE-787, dated October 17, 1975, to the Nuclear Regulatory Commission (NRC) and entered into discussions with them concerning the spurious movement of certain motor-operated valves (MOV's) in the Emergency Core Cooling System (ECCS) to a position defeating the ECCS function at a time when this function is required. On November 25, 1975, the discussion turned to the possible movement of a manually controlled, motor-operated valve due to a fault in its electrical circuitry and the NRC staff expressed concerns about other possible failure modes that might lead to such a valve movement. The NRC meeting minutes document these concerns. This report is an item-by-item response to the concerns expressed by the NRC staff at that meeting and incorporates the original electrical fault analysis.

42993 (WCAP—9221) **Westinghouse ECCS evaluation model, February 1978 version.** (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Feb 1978. 41p. Westinghouse Electric Corp., Pittsburgh, PA.

This report presents modifications to the Westinghouse (W) Emergency Core Cooling Systems (ECCS) evaluation model of October, 1975. The modifications are based on experimental and analytical work performed since the original W proposed model of August, 1974. It is recommended that these modifications be incorporated for all future ECCS design calculations.

42994 (WCAP—9273) **Westinghouse reload safety evaluation methodology.** Bordelon, F.M.; Dabby, D.; Fici, J.A.; Freeman, T.R.; Hollingsworth, S.D.; McAtee, K.R.; Meyer, L.F.; Richardson, D.C.; Risher, D.H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Mar 1978. 140p. Westinghouse Electric Corp., Pittsburgh, PA.

The report describes the reload safety evaluation methodology employed by Westinghouse. The goal of the reload safety evaluation is to confirm the validity of the existing safety analysis. The existing safety analysis is defined as the reference safety analysis and is intended to be valid for all plant cycles. Thus safety analysis input parameter values are selected to bound the values expected in all subsequent cycles. This bounding analysis concept is the key to the Westinghouse reload safety analysis methodology. When all reload safety related parameters for a given accident are bounded, the reference safety analysis is valid. On the other hand, when a reload parameter is not bounded, further evaluation is necessary. The purpose of this further evaluation is to confirm that the margin of safety as defined in the basis for any technical specification is not reduced. This reload safety evaluation methodology is applied whenever the input parameter values for a reference safety analysis are available. Thus the methodology may be employed for Westinghouse reloads in non-Westinghouse reactors, as well as Westinghouse reactors. Included in this report are (1) a systematic evaluation to determine whether the reload parameters are bounded by the values used in the reference safety analysis, and (2) a determination of the effects on the reference safety analysis when a reload parameter is not bounded to ensure that specified design bases are met.

42995 (WCAP—9281) **Westinghouse emergency core cooling system evaluation model for analyzing small LOCAs during operation with a loop out of service for plants without loop isolation valves.**

Monty, B.S.; Meyer, P.; Chismar, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1978. 54p. Westinghouse Electric Corp., Pittsburgh, PA.

This report describes the analytical models and computer programs to be used for performing Appendix K ECCS analyses for a small Loss-of-Coolant accident, which occurs during operation with a loop out of service (N-1 Configuration) on a plant without Loop Isolation Valves (LIV) or for plants which are not utilizing their loop isolation valves. Results of analyses for a Westinghouse 4 loop (17 x 17 fueled) plant having a 14 foot core are presented along with appropriate sensitivity studies to qualify the revised programs and models. The revised programs and models described in this report, in the judgement of Westinghouse, are in conformance with the requirements of Appendix K 10 CFR 50.46 and are applicable to all Westinghouse plants with 14 x 14, 15 x 15, 16 x 16, 17 x 17 fuel rod arrays. In fact, the modifications to the computer programs and models consist solely of extensions of existing programs to allow the modelling of the out of service loop using techniques that have been previously approved or are being submitted in parallel with this report. Therefore, it is recommended that the codes and models be approved for all future Westinghouse ECCS analyses for a small Loss-of-coolant accident which occurs during operation with a loop out of service on a plant without LIV's or for plants which are not utilizing their LIV's.

42996 Exact analytical solution of pool swell dynamics during depressurization by the method of characteristics. Vea, H.W.; Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA). Div. of Nuclear Engineering). *Nucl. Eng. Des.;* **45**: No. 1, 101-116(Jan 1978).

An exact analytical solution, based on the method of characteristics, has been obtained for the spatial and temporal variation of vapor volumetric (void) fraction in a depressurizing pool. Numerical evaluations have shown that the axial void profile is strongly dependent on the drift velocity formulation, and that wall heat flux plays only a minor role in the pool swell transient.

42997 Pressure build-up in a series of compartments after a steam-line break. Comparison of experimental results, obtained by Battelle-Institut, Frankfurt, with theoretical results. Blome, W. (Babcock - Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). pp 347-350 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 2. Sicherheit kerntechnischer Anlagn. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

If a coolant pipe of a nuclear reactor breaks within the containment the walls of the individual containment compartments are subject to differential pressure loads. By means of the experiment D1 of the Battelle experimental series it is to be shown with which models the real pressure transients can be approximated.

42998 BETHY code for the heat-up phase of fuel rods during LOCA. Depisch, F.; Guran, M. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). pp 379-382 of Reaktortagung, Hannover, 4.4.-.4.1978. Sektion 2. Sektion 2. Sicherheit kerntechnischer Anlagen. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

In order compute the fuel rod behavior during a loss-of-coolant accident the code BETHY was developed, being applicable for PWRs as well as BWRs. The theoretical models applied are briefly described and their influence on the can temperature behavior during an accident are demonstrated.

42999 Interface temperature criteria and the spontaneous triggering of small-scale fuel-coolant interactions. Dullforce, T.A.; Reynolds, J.A.; Peckover, R.S. (UKAEA Research Group, Abingdon. Culham Lab.). pp 258-261 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 2. Sicherheit kerntechnischer Anlagen. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978).

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

An important parameter in FCI experiments is the interface temperature and several criteria for the onset of FCIs have been based on it. The general validity of one, the superheat criterion, has been the subject of much debate. To extrapolate over the wide range of scale and simulant materials used in experiments to reactor materials and conditions it is necessary first to identify to which of several possible trigger mechanisms the superheat criterion is applicable and which mechanism is operative in a given circumstance. The results are presented of experiments which demonstrate the validity of the superheat criterion for spontaneous triggering in small drop experiments with three pairs of simulant materials.

43000 Model experiments on the thermodynamics of core melts. Fieg, G.; Werle, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). pp 266-269 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 2. Sicherheit kerntechnischer Anlagen. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

Propagation experiments of the melt front within a convection cell with density of the melting material $<=$ than to that of the melt itself.

43001 Modular assembly for supporting, straining, and directing flow to a core in a nuclear reactor. Pennell, W.E. (to Energy Research and Development Administration). US Patent 4,053,358. 11 Oct 1977. Filed date 30 Dec 1974. 10p.

PAT-APPL-537,516.

A reactor core support arrangement for supporting, straining, and providing fluid flow to the core and periphery of a nuclear reactor during normal operation is described. A plurality of removable inlet modular units are contained within permanent liners in the lower supporting plate of the reactor vessel lower internals. During normal operation (1) each inlet modular unit directs main coolant flow to a plurality of core assemblies, the latter being removably supported in receptacles in the upper portion of the modular unit and (2) each inlet modular unit may direct bypass flow to a low pressure annual region of the reactor vessel. Each inlet modular unit may include special fluid seals interposed between mating surfaces of the inlet modular units and the core assemblies and between the inlet modular units and the liners, to minimize leakage and achieve a hydraulic balance. Utilizing the hydraulic balance, the modular units are held in the liners and the assemblies are held in the modular unit receptacles by their own respective weight. Included as part of the permanent liners below the horizontal support plate are generally hexagonal axial debris barriers. The axial debris barriers collectively form a bottom boundary of a secondary high pressure plenum, the upper boundary of which is the bottom surface of the horizontal support plate. Peripheral liners include radial debris barriers which collectively form a barrier against debris entry radially. During normal operation primary coolant inlet openings in the liner, below the axial debris barriers, pass a large amount of coolant into the inlet modular units, and secondary coolant inlet openings in the portion of the liners within the secondary plenum pass a small amount of coolant into the inlet modular units. The secondary coolant inlet openings also provide alternative coolant inlet flow paths in the unlikely event of blockage of the primary inlet openings.

43002 Comment of fragmentation of UO_2 by thermal stress and pressurization. Ladisch, R. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 327-328(Sep 1977).

Various authors have proposed a mathematical mechanical model to describe UO_2-fragmentation during a fuel-coolant interaction. The assumptions of the models are discussed here. A comparison between the energy required to fragment the fuel plus the energy required to intermix the fragments with the coolant on one side and the mechanical energy being stored before fragmentation in the fuel on the other shows that the latter is sufficient to account for fragmentation but not sufficient to intermix the fragments with the coolant.

43003 Transient deformation of LMFBR cores due to local failure: experimental and theoretical investigation. Beutel, H.; Liebe, R.; Will, H.; Zehlein, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)); Rees, N.J.M.; Warren, G.R. (UKAEA Weapons Group, Foulness. Atomic Weapons Research Establishment). *Nucl. Eng. Des.;* **43**: No. 2, 381-410(Sep 1977).

This paper describes an effort to predict the mechanical core deformation caused by local failure within an LMFBR core. These activities are intended to cover all the potential core damage possibilities currently under discussion and analysis. In particular it is shown that the reactor can be scrammed in time under pessimistic-realistic pressure transients and that the damage does not exceed tolerable limits. A special gas generator technique to simulate a fuel coolant explosion has been developed at AWRE Foulness. This has been used to perform the explosion tests needed to demonstrate the safety of the SNR 300 core. A molten fuel-coolant interaction (MFCI) experimental facility, and a drop tower to carry out sub-assembly crushing tests are described. Theoretical studies are presented which use mass-spring-dashpot, lumped parameter-hinge or micro-rigid-lumped-mass models. They simulate the crushing and bending of a single sub-assembiy interacting with the coolant as well as the behaviour of a multirow 'spoke' model. For the core analysis only preliminary computational results are presently available which can be compared with the full scale tests in which the fluid pressure did not exceed a 'threshold' of about 100 bar. Parameter studies show the influence of pulse shape, material properties as well as the time integrator. Some of the unanswered questions concern the hydrodynamic feedback of the deformations on the pressure distribution in space and time. Also the behaviour of the highly irradiation-embrittled cores is poorly understood today. Finally, an enhanced

energy release package to describe the MFCI must still be added to the reactivity calculation module of a future fast reactor dynamics code.

43004 Flow rundown experiments in a seven pin bundle. Brook, A.J. (UKAEA Reactor Group, Risley); Kaiser, A.; Peppler, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 273-283(Sep 1977).

A series of experiments has been carried out using an electrically heated seven pin bundle to simulate the conditions under which boiling of the sodium coolant could occur in the event of the loss of power to the circulator pump of a fast reactor, coincident with a failure of the reactor to trip. Although it was not possible to represent the condition of the reactor exactly, nor to continue the tests far into dryout, the results nevertheless give valuable qualitative information on the course of boiling development as well as useful quantitative information against which the predictions of computer codes can be checked. In particular, data have been obtained relating to the incidence of superheat, the location and time to dryout of the residual liquid films, the void fraction within the boiling region, and the types of flow regimes which may be expected within different parts of the boiling region at various stages of the transient.

43005 Sodium boiling experiments in a seven-pin bundle: flow patterns and two-phase pressure drop. Kaiser, A.; Peppler, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 285-293(Sep 1977).

Two series of quasi-steady state sodium boiling experiments have been carried out in an electrically heated seven-pin bundle. The power levels (130-170 and 30-40 W/cm^2) and other test conditions were selected to correspond to the core and radial breeder zones of a typical LMFBR. The test procedures involved the gradual reduction of mass flow rate through the bundle in a simulation of the consequences of a slowly growing blockage in the lower part of a reactor subassembly. By this means it was possible to study the development of quasi-steady state boiling up to the onset of permanent dryout. The results obtained provide information of flow regimes in the two-phase region, vapour qualities and flow rates at which cooling of the bundle can be effectively maintained, and the ultimate incidence of dryout. A relation for the two-phase pressure drop multiplier obtained from adiabatic pressure drop measurements in this geometry is given and compared with earlier results from single-channel geometry tests.

43006 Sodium boiling experiments in a 7-pin bundle: investigations into some safety aspects of the KNK II driver zone. Kaiser, A.; Peppler, W.; Straka, M. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 411-417(Sep 1977).

A series of sodium boiling experiments, in which the thermohydraulic characteristics of KNK II driver subassemblies were simulated, has been carried out for the purpose of studying the effects of two types of cooling disturbances: rapid flow interruption and those flow reductions which develop rather gradually. Information about the spatial and temporal development of boiling, voidage and dryout was obtained. Furthermore the feasibility of individual subassembly temperature monitoring has been investigated as well as that of two integral boiling detection methods based on acoustic noise and reactivity measurements.

43007 Analysis of hypothetical overpower accidents in the SNR-300 Mark 1A core with modeling of failure incoherence. Royl, P.; Kuczera, B. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 239-248(Sep 1977).

Incoherency effects due to the statistical nature of fuel rod failure have been assessed for transient overpower (TOP) accidents with different initiating ramp rates. Characteristic single subassembly feedbacks from sodium voiding, fuel injection, and fuel sweep-out after failure were calculated and superimposed incoherently. Effective feedback functions were thus generated for characteristic subassembly groups (channels) and used as tabular reactivity input to corresponding multi-channel whole core TOP simulations using the HOPE computer model. Analyses were performed for the SNR-300 Mark 1A end of life (EOL) core with initiating ramp rates of 0.15, 0.5 and 5 S/sec. The results are compared with those from a calculation with coherent subassembly behavior in each channel. It is concluded for the mild transient that irrespective of the assumed axial failure location, negative fuel sweep-out reactivity from early failed subassemblies will prevent the accident from reaching a prompt critical stage and lead to a gradual shutdown if the assessed failure incoherencies are applied. For the higher ramp rates ($>=0.5$ S/sec) the assessed incoherencies will not always lead to an early shutdown, but they can considerably reduce the potential to accumulate high ramp rates in the initiating phase of TOP accidents.

43008 Calculation of temperature distribution in a melting clad with the Pekeris-Slichter series expansion method. Bottoni, M. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 249-257(Sep 1977).

The problem of temperature distribution in case of change of aggregation state is considered in cylindrical coordinates for a melting clad. The series expansion method introduced by Pekeris and Slichter for a problem of ice formation around a pipe is applied. The limiting assumption that the temperature in one region equals the fusion temperature has been removed. The analytical treatment is therefore generalized and temperature distributions in both phases are considered. A theoretical analysis of an in-pile experiment with clad melting and comparison of results with a discrete numerical approach confirms the applicability of the method to problems with fast transient conditions.

43009 In-pile sodium loop for investigation of local cooling disturbances in LMFBR's. Kramer, W.; Schleisiek, K.; Schmidt, L. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)); Vanmassenhove, G.; Verwimp, A. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). *Nucl. Eng. Des.;* **43**: No. 2, 343-351(Sep 1977).

In the safety analysis of Liquid Metal Fast Breeder Reactors, investigations of the fuel element behavior under local off-normal cooling conditions and the possible failure propagation are of special interest. In a common program, called 'Mol 7C' the Gesellschaft fuer Kernforschung, Karlsruhe, and the Centre de'Etude d l'Energie Nucleaire/Studiecentrum voor Kernenergie, Mol, are performing related in-pile experiments in a sodium loop in the BR 2-reactor The test section contains a 37-rod bundle of fresh UO_2-fuel. A local blockage within the fuel bundle will initiate a certain local damage to a few rods. The experiments are expected to obtain important informations with respect to the problems of pin to pin propagation and the long term behaviour of a fuel bundle with defect pins. The in-pile part of the loop contains the fully integrated primary sodium circuit. Total heat removal capacity is about 700 kW. The equipment for the first experiment is nearly manufactured. The first experiment will start in the beginning of 1977. At first three experiments are planned.

43010 Design of the HDR experimental program on blowdown loading and dynamic response of PWR-vessel internals. Krieg, R.; Schlechtendahl, E.G.; Scholl, K.H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 419-435(Sep 1977).

In reactor safety, a postulated breach of the primary coolant circuit, i.e. a reactor vessel blowdown, must not result in an uncontrolled failure propagation. Therefore deformations on the pressure vessel internals caused by the sudden pressure release within the first milliseconds of the blowdown must be within certain limits. To guarantee this, up to now conservative assessments are used based on theoretical models and a number of small scale experiments. In the next two years full scale blowdown experiments will be performed at the former HDR-reactor. They will be used to verify state-of-the-art and newly developed computer codes. In order to obtain reliable information on the safety margins in case of a blowdown, conservative approaches are replaced by the more detailed models of best estimate codes. Especially the coupling between fluid- and structural dynamics, i.e. the feedback of the structural deformations on the blowdown loading will be taken into account. In this paper the design of the HDR-experiments and the accompanying program of computer code development is discussed.

43011 Theoretical interpretation of SCARABEE single pin in-pile boiling experiments. Struwe, D.; Bottoni, M.; Fries, W.; Elbel, H.; Angerer, G. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 259-271(Sep 1977).

In the framework of LMFBR safety analysis a theoretical interpretation of some of the most representative of the single pin experiments of the in-pile SCARABEE project has been performed from both viewpoints of thermohydraulic and fuel behaviour using the computer codes CAPRI-2 and SATURN-1. The analysis is aimed at investigating the pin behavior from the preirradiation history, through the observed sequence of events following a coolant mass flow reduction from boiling inception up to pin breakdown. A comparison of theoretical results with experimentally recorded data has allowed a deeper insight into the peculiar features of the experiments and enabled a valuable code verification.

43012 Legal natures of security contract for nuclear power plants. Ara, H. (Tsukuba Univ. (Japan)). *Genshiryoku Kogyo;* **23**: No. 7, 12-15(Jul 1977). (In Japanese).

A variety of theories on the legal natures of the security agreement for nuclear power plants, and the author's opinion are described. The discussed theories include (1) the theory of gentleman agreement, (2) the theory of contract under private laws, (3) the theory of contract under public laws, (4) the theory of administrative guidance, (5) the theory of quasi-laws and rules, (6) the theory of mixed contract, and (7) the theory of special contract. According to the author's opinion, it may not be a pure gentleman agreement, but

it can be a contract under public laws with quasi-regulation-like features. Reviewing the security agreement in such circumstance, the following measures should be taken. (1) the prescription of doctrine or declaration about the respect of environment and human life must be specified; (2) technical matters must be specified as concretely as possible; (3) resident representatives must participate in planning measurements and treating the results of measurements; (4) the contract must be effective in case of the transfer, incorporation and succession of enterprises; (5) the subrogation of administration acts must be recognized; (6) a unified line of command must be provided and bearing of expenditures must be prepared legally for emergency, because the executive organization of immediate compulsion has not sufficient knowledge on radioactivity; and (7) the active obligations of enterprises to cooperate with the administrative guidance and investigation by local public bodies must be specified.

43013 Study on fuel behavior under reactivity-initiated accident condition. Ishikawa, M.; Ohnishi, N. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Karyoku Genshiryoku Hatsuden;* **28**: No. 5, 425-432(May 1977). (In Japanese).

The study on the fuel behavior under reactivity-initiated accident condition was conducted using NSRR in Japan Atomic Energy Research Institute, which is a large scale pulsed reactor, and attained the criticality in June, 1975. The outline of the reactor design, the capsule and loop for experiment, and especially the pulsed output property of the NSSR are explained. As for the experimental results on fuel breaking, the items of experiments, the behavior of fuel clads and pellets under reactivity-initiated accident condition, the effect of gap between a fuel clad and pellets on fuel behavior, and the behavior of fuel clads with defects, through which water enters inside and the internal pressure increases rapidly at the reactivity-initiated accident condition, are reported in this paper.

43014 Analysis of accidents of pressurized water reactors in supercritical state. Tinka, I. *Jad. Energ.;* **23**: No. 4, 147-150(Apr 1977). (In Slovak).

Accident types are described due to criticality rise in uncontrolled control rod removal, in control rod ejection, in refuelling, in boron concentration changes, and in the introduction of cold water in the reactor core. Common methods for the analysis of the above accidents are given and four systems of WWER type reactor accident protection are described.

43015 Concrete containment vessels (CCV) for nuclear power plants, (1). Ibe, Y.; Kitajima, M. (Ministry of International Trade and Industry, Tokyo (Japan)). *Hatsuden Suiryoku;* No. 147, 63-68(Mar 1977). (In Japanese).

Containment vessels (CV) and the construction of concrete containment vessels (CCV) for nuclear power plants are described generally, and their use and techniques in foreign countries are illustrated, in connection with the introduction of CCV to Japanese nuclear power plants. The introduction deals with the construction plan of Japanese nuclear power plants, and with the difficulties in the steel CV for large scale construction. The investigations, tests and researches are not yet sufficient. The prompt establishment of safety supported by technical criteria, analytical methods and experiments is desired. The second part deals with the consideration for aseismatic design, construction, function and characteristics of CCV. The classification and currently employed CCV, which is mainly reinforced concrete containment vessels (RCCV), are described, and the typical CCV employed for BWR is illustrated. Further, the typical arrangement of reinforcing steels at the cylindrical portion and the dome portion of RCCV is illustrated. The third part deals with the present state of CCV abroad. A prestressed concrete containment vessel (PCCV) of Turkey Point power plant is illustrated as a typical example of CCV. The tests reported in the international meeting for the design, construction and operation of concrete pressure vessels and concrete containment vessels at York University in England in 1975 are reviewed. Typical examples of the design conditions, the size and form, and the construction procedure for PCCV and RCCV abroad are reviewed.

43016 Heat transfer model of quenching in reflooding phase. Kaminaga, F.; Uchida, H.; Saito, T. (Tokyo Univ. (Japan). Faculty of Engineering). *J. Fac. Eng., Univ. Tokyo, Ser. B;* **34**: No. 1, 59-66(Mar 1977).

Experimental and analytical investigations on the reflooding process during the emergency core cooling in a light water reactor are presented. The experiments were made by using an electrically heated stainless tube (1 m long, 10 mm OD, 8 mm ID) as a simulated fuel rod. Taking into account the transient heat transfer for film boiling region around a quench point, an analytical method to predict the quench time of a specified position on the heated tube surface is proposed. The calculated results of the time variations of the wall temperature and the quench point elevation agree well the experimental results obtained.

43017 Current status of nuclear safety research. *At. Jpn.;* **21**: No. 2, 27-39(Feb 1977).

Efforts at nuclear safety research have expanded year by year in Japan in terms of money and technical achievement. The Atomic Energy Commission set last year the five year nuclear safety research program, a guideline by which various research institutes will be able to develop their own efforts in a concerted manner. From the results of the nuclear safety research which will cover very wide areas ranging from reactor engineering safety, safety of nuclear fuel cycle facilities, prevention of radiation hazards to the adequate treatment and disposal of radioactive wastes, AIJ hereafter focuses on LWR engineering safety and presents two articles, one introducing the current results of the NSSR program developed by JAERI and the other reporting the LWR reliability demonstration testing projects being promoted by MITI. The outline of these demonstration tests was reported in this report. The tests consist of earthquake resistance reliability test of nuclear power plants, steam generator reliability tests, valve integrity tests, fuel assembly reliability tests, reliability tests of heat affected zones and reliability tests of pumps.

43018 Analyses of occupational radiation exposure received at Gundremmingen nuclear power station, and its implications on the design of current and future power plants. Eickelpasch, N. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (Germany, F.R.)); Pfeiffer, K.W.; Peter, H. (Kraftwerk Union A.G., Offenbach (Germany, F.R.)). pp 667-669 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Vol. 2. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977).

In 1976, the 250 MW Gundremmingen nuclear power station (KRB) completed its first decade of operation. The accumulated activity built-up due to corrosion products in the primary system, the condition of the plant and the methods of radiation work management determine the occupational exposure. The development and the general features of these three parameters are presented in detail. Job related exposure accounting has proven to be an effective means of radiation management. By this means up to 90% of the total radiation exposure could be traced with an accuracy of about 10 mrem. It is shown that up to 40% of the total exposure originate not from primary work but from associating jobs, e.g. work area preparation and testing efforts. Especially in this field a remarkable reduction of the occupational dose rate can be achieved by precise planning. The ten-year radiation protection history of KRB served as a design basis with the objective to reduce occupational radiation exposure. Examples are given how this influenced not only the design of relevant systems but also their accomodation, arrangement and shielding with regard to maintenance and repair work during reactor outage. Physical separation of the components and valves from the associated actuators, controls and instruments was provided to reduce personnel radiation exposure during plant operation. Provisions were also made to avoid contamination of the building atmosphere and to reduce the release of radioactivity via the ventilation systems.

43019 RSIC after 14 years - where do we go from here. Trubey, D.K.; Maskewitz, B.F.; Roussin, R.W. (Oak Ridge National Lab., Tenn. (USA). Radiation Shielding Information Center). *Atomkernenergie;* **30**: No. 4, 303-304(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

During the fourteen years since the Radiation Shielding Information Center (RSIC) started operations, many changes have taken place in the nuclear industry, both government and commercial, and in shielding technology. With the present need to meet energy demands through nuclear power, and yet to minimize radiation exposure to operating personnel and the public, there is great need to increase radiation analysis capabilities among the utilities and other segments of the industry. During 1975, RSIC had an Electric Power Research Institute (EPRI) contract to integrate the shielding and technology information exchange of the nuclear power industry with that of the government and its contractors. Included in work performed by RSIC on behalf of EPRI was a survey of the radiation protection, radiation transport, and shielding information needs of the nuclear power industry. Such needs include computing technology, nuclear data, special information needs, such as fission product and 'crud' transport, and expansion more generally into radiation protection areas such as environmental radiological analysis.

43020 Safety rules for nuclear power plants by the International Atomic Energy Agency. Invitation to critical comments. *GRS Kurz-Inf., Reihe C;* No. 41, 1-2(1977). (In German).

The Ministry of the Interior has been sent the 'Safety Guide on Quality Assurance Records System (SG-QA2)' of the IAEA for a final comment on the part of the FRG. Proposals for amendment are invited until the 13.1.1978, and to be addressed to the GRS.

43021 Leak rate tests on the containment of the HDR plant. Engel (Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)); Mueller, K. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Heissdampfreaktor-Sicherheitsprogramm). *KFK Nachr.;* **9**: No. 2, 56-60(1977). (In German).

Leak rate tests are carried out in order to prove the leak-tightness of nuclear power plant containments. The leak rate is defined as the gas mass escaping daily from the containment related to the gas mass present in the containment at the beginning of the test. During leak rate testing, the plant is out of operation. The HDR studies aim at clarifying problems still open in recurring leak rate tests. The findings will enable a standardisation of procedures for low-pressure measuring of leak rates.

43022 'Earthquake studies' on the Kahl superheated-steam reactor (HDR) (EV 4,000). Jehlicka; Malcher (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Heissdampfreaktor-Sicherheitsprogramm); Steinhilber. *KFK Nachr.;* **9**: No. 2, 49-55(1977). (In German).

In nuclear power plant licensing, it is necessary to design safety-relevant systems so as to withstand earthquake forces. This means that these systems or components must be designed in such a way that they can also take up earthquake loads apart from the normal primary and secondary loads. While primary and secondary loads can usually be determined with statistical methods, dynamic methods are required to determine the structural behaviour after vibrational excitation. There is a large number of computer codes for these. The seismic studies at the HDR are used for testing and optimisation of these codes.

43023 Survey of rewetting following a postulated LOCA. McAssey, E.V.; Bonilla, C.F. New York; American Society of Mechanical Engineers (1977). 8p. (COO—3027-35).

From National heat transfer conference; Atlantic City, NJ, USA (15 Aug 1977).

See CONF-770802—11.

Available open literature on rewetting following a postulated LOCA has been examined. Comparisons have been made between several of the current theoretical analyses. Examination of the theoretical and experimental results indicates that considerable scatter exists in the prediction of rewetting velocity.

43024 Nuclear hazard/fire hazard: an elusive and important linkage. Mariani, L.P. Washington, DC; Atomic Industrial Forum, Inc. (1977). 11p. (CONF-7705116—12).

From AIF's workshop on insurance; Atlanta, GA, USA (8 May 1977).

The Brown's Ferry Fire signaled a yellow alert for nuclear safety related fire protection and showed that fire protection engineering must be regarded as a bona fide nuclear discipline. A single-failure design criteria violation resulted in fire damage to plant systems and plant instrumentation. Localized damage lead to significant consequences. Although the linkage between fire and nuclear hazard is termed subtle, effective standards and criteria development must be aimed to future plants. Combined fire protection and nuclear engineering inspections are planned.

43025 Core catcher in a reactor. Kudo, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-70294/A/. 10 Dec 1975. 6p. (In Japanese).

A method is described to arrange a material, whose specific gravity is greater than molten nuclear fuel material and melting point is lower than temperature of coolant during operation of the reactor, close to a lower outer peripheral portion of a reactor container to positively prevent development of melt-through trouble. When molten nuclear fuel drops on the bottom within a reactor container resulting from occurrence of melting trouble in a fast breeder, through holes are formed in the bottom of the reactor container. Molten lead in an area of molten lead flows into the pressure vessel of the reactor through the through holes to form a boundary between sodium and molten lead in a level in which pressure in the reactor container is balanced. At this time, since the molten nuclear fuel is smaller in specific gravity than that of molten lead, the molten nuclear fuel is afloat in the neighbourhood of the boundary to prevent outflow thereof toward outside the reactor container.

43026 Boiling water reactor. Matsumoto, T.; Inoue, K.; Ishida, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-68699/A/. 5 Dec 1975. 4p. (In Japanese).

A method to connect a feedwater pipe to a recycling pipe line, the recycling pipe line being made smaller in diameter, thereby minimizing loss of coolant resulting from rupture of the pipe and improving safety against trouble of coolant loss is described. A feedwater pipe is directly connected to a recycling pipe line before a booster pump, and a mixture of recycling water and feedwater is increased in pressure by the booster pump, after which it is introduced into a jet pump in the form of water for driving the jet pump to suck surrounding water causing it to be flown into the core. In accordance with the abovementioned structure, since the flow of feedwater can be used as a part of water for driving the jet pump, the flow within the recycling pipe line may be decreased so that the recycling pipe line can be made smaller in diameter to reduce the flow of coolant in the reactor, which flows out when the pipe is ruptured.

43027 Shock absorber for protecting the upper lattice of a reactor from earthquake. Hayashi, E.; Akimoto, S. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-67481/A/. 3 Dec 1975. 4p. (In Japanese).

A method is described to prevent a lateral shift in the upper lattice at the time of an earthquake in any state of operation of a reactor including the start-up and shut-down thereof by considering relative displacement of component members due to a difference in their coefficients of thermal expansion at the time of high reactor temperatures. The upper lattice and core shroud supporting the lattice are formed from materials having different coefficients of thermal expansion. A plurality of restraints are mounted on the stainless steel core shroud in the direction thereof, and a wedge-shaped restraint stopper is interposed between each restraint and the upper lattice which is made of an inconel material offering high earthquake resistance.

43028 Nuclear reactor container. Henmi, Y.; Inoue, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-66187/A/. 1 Dec 1975. 5p. (In Japanese).

In a nuclear reactor container having a drywell and a pressure suppression chamber, a method is described to provide an arrangement such that the valve body of a vacuum breaker cannot be closed after it is once opened unless it is intentionally operated. Structure: Between the drywell and pressure suppression chamber there is provided a vacuum breaker functioning to open the valve body with a pressure difference produced when the pressure in the drywell becomes lower than the pressure in the pressure suppression chamber. The vacuum breaker has a counter weight which applies a rotational moment acting against the rotational moment of the valve body tending to return to the closed position by its own weight after it has been opened with the afore-mentioned pressure difference. Thus, once the valve body is opened, it is held in the open position unless it is intentionally operated.

43029 Reactor containment vessel. Kawashima, H.; Naito, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-59289/A/. 10 Nov 1975. 5p. (In Japanese).

A method is described to restrain a rise in pressure within a sealed space in a sodium cooled fast breeder, such rise in pressure being formed within a reactor vessel as a result of failure of coolant. A good thermal conductive member such as a heat pipe is disposed between a plurality of spaced sealing spaces for receiving a cooling system. When sodium leaks within one sealed space to cause a temperature to rise, part of the temperature is directly cooled by means of an atmosphere control system within own chamber while the other part of the temperature is transmitted to the other chamber by means of the heat pipe and is cooled by means of the atmosphere control system therein.

43030 Piping penetration. Asanuma, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57491/A/. 7 Nov 1975. 3p. (In Japanese).

A method to permit setting error of penetration to be absorbed while facilitating the operation of adjustment is described. A fluid head is supported such that it can be adjusted by an adjustment bolt provided on a short bellows tube, with its diameter made smaller than the inner diameter of the short bellows tube.

43031 Fuel assembly for reactor. Ishida, M.; Matsumoto, T. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-57490/A/. 7 Nov 1975. 9p. (In Japanese).

A method to improve the spray cooling function of an emergency core cooling system by providing holes in the channel wall of a fuel assembly used for the boiling water type reactor in the neighborhood of the lower end of the channel wall is described. The lower end of a channel wall enclosing the assembly of fuel rods in a fuel rod assembly used for a boiling water type reactor is provided with holes. At the time of emergency core cooling, spray water collected in the flow path of the fuel assembly through the afore-mentioned holes is effectively led into the interior of the fuel assembly. In this way, while cooling the fuel rods in a high temperature state, an increase in the lower plenum water level is accelerated and spray cooling is further reinforced.

43032 Method of removing iodine in reactor container. Kikuchi, M.; Uchida, S. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-56297/A/. 4 Nov 1975. 5p. (In Japanese).

A method to permit radioactive organic iodine within the reactor container of a boiling water type reactor to be removed effectively and in a short period of time at the time of the accident of

loss of the coolant in the reactor is described. At the time of an accident, a cooling water is sprayed into the reactor container simultaneous with the spraying of an organic solvent with a greater iodine solubility than that of the cooling water (such a carbon tetrachloride, chloroform, methylene, chloride, benzene and so forth).

43033 Apparatus for pouring emergency cooling water. Shirakawa, T.; Otsuji, N. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-56298/A/. 31 Oct 1975. 5p. (In Japanese).

A method to reliably cool a fuel rod by providing a cooling water guide tube within a channel box in a boiling water type reactor is described. A cooling water guide tube is accommodated parallel to fuel rods within a channel box in a boiling water type reactor. The cooling water guide tube is provided at the upper end with a funnel-like opening section and has a side wall formed with holes. When the level of the coolant within the reactor is lowered, cooling water is sprayed from a spray means onto the fuel assembly, and it is partly led to flow from the funnel-like opening to the cooling water guide tube and thence is sprayed from the holes into the channel box to cool the fuel rods.

43034 Apparatus of holding molten fuel in a reactor. Nagashima, K. (Nippon Atomic Industry Group Co. Ltd., Tokyo). (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1977-53197/A/. 25 Oct 1975. 3p. (In Japanese).

A method to dispose below a reactor container, a sealed container receiving therein cooling medium and a molten fuel holding mechanism and provided with a cooling mechanism whose top plate is in a shape capable of receiving molten fuel thereby preventing an occurrence of re-criticality of molten fuel caused by accidents and to perform positive cooling is described. The molten fuel fallen through the reactor container due to accidents is diffused and stored on the top plate formed with an annular concave portion of a V-shaped section prevent an occurrence of re-criticality and thereafter falls into the molten fuel holding mechanism while being cooled by sodium resulting from destruction of top plate, causing a neutron absorbing material to absorb the neutron.

43035 Atomic power plant. Toyoumi, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-52088/A/. 24 Oct 1975. 5p. (In Japanese).

A method to provide an atomic power plant including a turbine, which assures that even if the turbine should be destroyed, scatterred bodies of the turbine would not absolutely impinge upon the reactor building and control building is described. A plate for reflecting scattered bodies of turbine is provided at least partly of a turbine casing. That is, a plate for reflecting scatterred matter, of which mass is more than one third of a turbine disk and tip angle is less than 30^{0}, is mounted on an outer casing of the turbine in such a manner that an axial mounting angle and a peripheral mounting angle are respectively more than 5^{0}, so as to positively reflect the scatterred bodies.

43036 Nuclear fuel assembly. Matsumoto, T.; Miki, K. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-40293/A/. 25 Sep 1975. 3p. (In Japanese).

A method to increase the efficiency of core spray cooling used in case of an emergency accident such as an accident of loss of coolant is described. In a fuel assembly of a BWR type nuclear reactor, the upper tie plate for securing the fuel rod is constructed as a double-stage structure, and the fuel rods are made to have different lengths between those in the central portion and those in the edge portion. With the flow path formed in the upper tie plate the interaction between the vapor generated in the inside of the fuel assembly and core spray water from above is reduced, permitting both the fluids to smoothly flow in and out and thus increasing the efficiency of core spray cooling.

43037 Liquid metal cooled nuclear reactor. Nozue, Y.; Igarashi, T.; Yamaguchi, A. (to Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan)). Japanese Patent 1977-29599/A/. 1 Sep 1975. 2p. (In Japanese).

Object: To ensure the coolant safety level at the time of the coolant leakage accident by connecting the liquid metal cooled nuclear reactor and guard vessel for holding the coolant safety level. Structure: At the time of a rupture accident in the primary cooling system, the coolant flowing out from the ruptured portion is at the guard level. The surplus portion of the coolant flowing out overflows to the duct, and it is returned through a coolant purifying means and cooling means to the reactor vessel by a circulating pump. In this way, the safety level of the coolant in the reactor container can be ensured.

43038 Control equipment for emergency cooling system. Watanabe, T.; Kuwayama, M. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1977-29598/A/. 29 Aug 1975. 7p. (In Japanese).

A method to improve the standby state of an emergency reactor core cooling system for a fast breeder reactor and increase the heat removal effect at the time of the start is described. An electromagnetic pump for an emergency reactor core cooling system is excited in reverse phase in the standby state so as to restrict the rate of natural circulation and thus hold the liquid metal at a low temperature. At the time of start, the electromagnetic pump is excited in the right phase from an emergency power source.

43039 Liquid metal cooled nuclear reactor. Nozue, Y.; Igarashi, T.; Yamaguchi, A. (to Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan)). Japanese Patent 1977-25998/A/. 21 Aug 1975. 3p. (In Japanese).

A method to provide a liquid metal cooled nuclear reactor having a safeguarding means having both the function of level adjustment of the coolant in a reactor container at the time of normal operation and the function of cooling the reactor core in case of emergency at the time of accident of the coolant is described. At the time of normal operation, coolant cooled by a cooling means within a safeguarding tank is led into and out of the reactor container via the duct to hold the normal level of the coolant constant. At the time of a loss-of-coolant accident due to rupture of the duct in the primary cooling system, a pump within a safegurading tank is driven to supply the coolant through duct to the reactor container so as to hold the level of the coolant to be above the safety level.

43040 Safety of nuclear power stations. Marchildon, P. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). pp 19 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session II, Paper 3. Montreal, Canada; Ecole Polytechnique ([nd]). (In French)

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

The CANDU reactor employs dual emergency shutdown systems consisting of scram rods and liquid poison injection. Containment is multi-level. Emergency cooling is accomplished with gravity fed core flooding. Safety engineering and inspection programs make accident risks very slight. The radiation doses associated with normal and abnormal operation are explained.

ACCIDENT LIABILITY

43041 Unconstitutionality of Section 170 (e) of the Price Anderson Act. *Nucl. Law Bull.;* No. 19, 20-23(May 1977). (In English, French).

Several environmental protection groups in the State of North Carolina have recently contested the conformity with the United States Constitution of Section 170 (e) of the Atomic Energy Act (Price-Anderson Act). The court seized of the question (the United States District Court for the western district of North Carolina, Charlotte Division) held in March 1977 that this Section and the other provisions of the Atomic Energy Act concerning implementation of the $560 million limitation of liability for nuclear damage were unconstitutional and unenforceable insofar as they applied to nuclear incidents occurring inside the United States. The defendants, the former United States Atomic Energy Commission and its then Commissioners as well as the Duke Power Company (the local electricity company) will appeal this decision. The note on case law analyses the arguments retained by the court.

43042 Report from the nuclear insurance pools. Senger, L.F. Washington, DC; Atomic Industrial Forum, Inc. (1977). 16p. (CONF-7705116—1).

From AIF's workshop on insurance; Atlanta, GA, USA (8 May 1977).

Brief comments are made on events and developments during 1976 which affected the nuclear insurance industry. (DG)

43043 Atti dell'incontro di diritto nucleare. (Proceedings of the meeting on nuclear law held by the Centro Italiano di Studi di Diritto dell'Energia Nucleare in Rome, Italy, 24 November 1975). Roma; CISDEN (1976). 111p. (In Italian).

From Meeting on nuclear law; Rome, Italy (24 Nov 1975).

In accordance with usual practice the Italian Centre for Study of Nuclear Law (CISDEN) organised a meeting on nuclear law in Rome. A series of papers were presented dealing in particular with the respective legal positions of operators and constructors of nuclear power plants in Italy, the requirements and standards, national and international, imposed on users of radioactive materials and equipments. In addition, a series of conclusions are drawn from the Inter Jura' 75 Congress organised by the International Nuclear Law Association, as well as from the 1974 London Conference on Nuclear Insurance and Indemnity which dealt in detail with nuclear insurance problems for nuclear equipment and materials and their transport, in Europe and the United States. Finally, it is made clear from the III Symposium on German Nuclear Law organised in Goettingen in 1974 that the Federal Republic of Germany is concen-

trating on further developing its nuclear legislation in step with nuclear developments, in particular regarding compensation for possible victims of a nuclear incident.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 43226

FLYWHEELS

REFER ALSO TO CITATION(S) 43338

43044 (AD-A—048076) **Structural analysis and testing for composite flywheel development. Final report 24 Jan—3 Sep 77.** Johnson, D.E. (Avco Systems Div., Wilmington, Mass. (USA)). Sep 1977. Contract DAAG46-77-C-0017. 68p. NTIS PC A04/MF A01.

Several effects that can limit the performance of bi-directionally reinforced composite flywheels are investigated. These effects include potential shear failures, degraded properties and variations caused by manufacturing. Finite element analyses are used to determine both the in-plane and interlaminar shear stresses that arise from the discreteness of the individual radial reinforcements. The degradation of material properties due to high biaxial stress levels, especially a drop in shear modulus, is also investigated. Degraded properties are obtained experimentally and used in the evaluation of flywheel performance. Also included is an analysis to determine the feasibility of a static simulation test. In addition, the effect of asymmetric material property variation on flywheel imbalance was investigated.

43045 (UCRL—50019-77-2, pp 2-4) **Flywheel program.** 19 Jan 1978.

In Organic Materials Division quarterly report, April—June 1977.

Research progress is reported on the following subjects: (1) composites with flexible epoxy-resin matrices; (2) cure cycles for epoxy-resin/fiber composites; and (3) rubber-modified resins for fiber composites. (TFD)

43046 **Composite materials in the design of high energy flywheels. II.** Crivelli Visconti, I.; Rodriguez, F.; Sorrentino, V.; Volpe, G.P. (Univ di Napoli, Italy). *Quad. Ric. Progettazione;* No. 8, 210-214(Jan-Feb 1977). (In Italian).

Part 2 of the article describes a design method for flywheels and gives tables of characteristics of some flywheels constructed from different composite materials, with a single ring gear and with multiple ring gears. Sixteen examples of flywheel design are presented. All the flywheels considered are cylindrically shaped.

THERMAL

REFER ALSO TO CITATION(S) 42515, 42536, 42555, 42888, 43102

BATTERIES

REFER ALSO TO CITATION(S) 42473

43047 (NTIS/PS—77/1088) **Magnesium batteries (citations from the NTIS data base). Report for 1964-Dec 77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 132p. NTIS PC N01/MF N01.

Studies on seawater batteries, dry tape batteries, storage batteries, primary batteries, and reserve batteries are cited. Design, development, electrochemistry, components, reliability, and testing are covered in this compilation of Federally-funded research. (This updated bibliography contains 127 abstracts, 14 of which are new entries to the previous edition.)

DESIGN AND DEVELOPMENT

43048 (EPRI-EM—711) **Development of high-efficiency cost-effective, zinc—chlorine batteries for utility peak-shaving, 1976. Interim report.** Symons, P.C. (Energy Development Associates, Madison Heights, Mich. (USA)). Mar 1978. 277p. Dep. NTIS, PC A13/MF A01.

The two principal thrusts of this program were battery scale-up by a factor of twenty from earlier work and investigation of the economics of zinc—chlorine peak-shaving batteries located at utility substations. Development programs on cell performance, electrode research, and materials of construction were conducted in support of these objectives. A battery was designed, built, and tested which delivered 18 kWh dc at an electrochemical energy efficiency of 60 percent. This scale-up from a 1 kWh system was successful despite difficulties with excessive hydrogen evolution and zinc dendrite formation during initial testing. Two smaller systems were built and tested in order to permit informed selection of the chlorine-electrode material. Porous graphite was chosen over ruthenia-catalyzed porous titanium because of considerations of ultimate cost, ease of system operability, and system safety. The cycle-testing of two battery systems was successfully automated. Experience with the automation activities indicated that the zinc—chlorine battery system can operate (charge and discharge) for extended periods without human intervention. Two conceptual designs—Mark 2 and Mark 3—of a 100-MWh (20-MW) zinc—chlorine battery plant were prepared. A detailed cost breakdown was provided for each design. In a mature market, the selling prices of the Mark 2 and Mark 3 plants would be $25/kWh and $21/kWh (1976$), respectively. These selling prices coupled with a 70 percent ac to ac storage efficiency would make the battery plants highly competitive with fossil fuel-consuming combustion turbines from an electricity-cost standpoint. 102 figures, 36 tables.

43049 **Cell casing and a hermetically sealed sodium—sulfur cell.** King, R.N. (to General Electric Co.). US Patent 4,084,040. 11 Apr 1978. Filed date 28 Feb 1977. 14p.

A cathode cell casing and a hermetically sealed sodium—sulfur cell are disclosed. The metallic cathode cell casing is made of one of several specific metals. The cell casing includes also an opposed anode cell casing portion joined to a ring supporting an inner casing of a solid sodium ion-conductive material. A hermetically sealed sodium—sulfur cell has the above type of casing with a sodium negative electrode in the inner casing and a positive electrode of sulfur in conductive material in the cathode casing portion surrounding the inner casing. A high-resistance electrical wire is positioned within the inner casing, contacts its closed end, and extends to and contacts the interior surface of the anode casing portion. 2 figures.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 43060

43050 (AD-A—047658) **Development of lithium inorganic electrolyte batteries for navy applications. Research and development report Jul 74—Feb 77.** McCartney, J.F.; Shipman, W.H.; Gunderson, C.R.; Koehler, C.W. (Naval Undersea Research and Development Center, San Diego, Calif. (USA)). Feb 1977. 106p. (NUC-TP—564). NTIS PC A06/MF A01.

The Naval Undersea Center (NUC) has completed an extensive test program of lithium—thionyl chloride ($SOCl_2$ cells of both the high-rate and low-rate configurations. Several deficiencies of earlier cells were corrected by modifying cell hardware design and the addition of chemical additives to the electrolyte for improved safety. As a result of this program, the improved cells are now being used, with complete success, in numerous ocean-oriented applications. Now that many of the problems and hazards of these cells are better understood, lithium—thionyl chloride cells and batteries can be developed for a variety of high- and low-rate applications involving both large- and small-size cells.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 43049, 43248

43051 (AD-A—047881) **Battery charger PP-7286 ( )/U. Final report Jul 76—Jun 77.** Woodward, J.; Waldstein, S. (RCA Government and Commercial Systems, Burlington, Mass. (USA). Automated Systems Div.). Dec 1977. Contract DAAB07-74-C-0270. 82p. NTIS PC A05/MF A01.

The Battery Charger PP-7286 ( )/U was developed to support the Laser Rangefinder MX-9838 ( )/GVS-5, which is powered by a rechargeable nickel/cadmium battery, type BB-516 ( )/U, and other Army equipment using generically similar batteries. The technical characteristics are described in ECOM Development Specification Number EL-CP2128-0001A. The hardware developed consisted of the Battery Charger PP-7286 ( )/U and its Transit Case CY-7670 ( )/U. The Battery Charger operates from prime power of 115 or 230 V (plus or minus 10%) 47 to 63 Hz ac. It provides five independently adjustable charging circuits, each capable of being set to charge at constant current rates from 15 through 700 milliamperes inclusive. A multiple scale meter can be switched to measure current in each of the five channels. The circuits provide constant current into any load from zero volts (short circuit) to 36 volts. A digital timer common to all circuits can be set in tenths of an hour increments from 0.1 to 19.1 hours. Time remaining in the charging cycle is

displayed by an incandescent, seven segment, 3 digit display. An internal primary battery provides nonvolatile memory for the charger in the event of power interruption. A sixth position on the meter switch allows the voltage of this battery to be measured.

43052 Method and apparatus for conditioning of nickel—cadmium batteries. Kapustka, R.E. (to National Aeronautics and Space Administration). US Patent 4,084,124. 11 Apr 1978. Filed date 24 Nov 1976. 6p.

A method and apparatus for reconditioning batteries utilizing a dc—dc converter are described. During a discharge of the batteries, each cell is monitored by the converter. When the voltage of a cell decreases to a predetermined level, a converter will assume the load of this cell and inhibit the voltage from reaching zero, and thereby prevent voltage reversal of that cell.

43053 Stable alkaline zinc electrode. Himy, A.; Wagner, O.C. (to Secretary of the Navy). US Patent 4,084,047. 11 Apr 1978. Filed date 29 Nov 1976. 16p.

A zinc electrode containing a minor amount of Tl_2O_3, PbO, CdO, or mixtures of Tl_2O_3 and PbO, Tl_2O_3 and CdO, Tl_2O_3 and SnO_2, Tl_2O_3 and $In(OH)_3$, Tl_2O_3 and Ga_2O_3, PbO and CdO, PbO and SnO_2, PbO and $In(OH)_3$, and PbO and Ga_2O_3 reduces "shape change" and hydrogen gassing of the zinc electrode which is used as the anode in an alkaline battery. 2 tables.

43054 Secondary battery or cell with polysulfide wettable electrode No. 2. Ludwig, F.A. (to Ford Motor Co.). US Patent 4,084,041. 11 Apr 1978. Filed date 22 Mar 1977. 14p.

An improved secondary battery or cell has one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit; one or more cathodic reaction zones containing a cathodic reactant; a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones; and an electrode which is disposed within the cathodic reaction zone. The cathodic reactant, when the battery or cell is at least partially discharged, is selected from the group consisting of a single-phase composition comprising molten polysulfide salts of the anodic reactant and a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant. The electrode within the cathodic reaction zone is at least partially immersed in the cathodic reactant and in electrical contact with both the cation-permeable barrier and the external circuit. The improvement comprises employing an electrode, at least a portion of which consists essentially of a carbon-based porous conductive material which is coated with a material which renders the electrode portion more readily wettable by molten polysulfide than by molten sulfur, does not fill the entire volume of the cathodic reaction zone, and is, at least in part, adjacent to and contiguous with the cation-permeable barrier. 1 table.

43055 Secondary battery or cell with polysulfide wettable electrode No. 1. Ludwig, F.A. (to Ford Motor Co.). US Patent 4,084,042. 11 Apr 1978. Filed date 22 Mar 1977. 14p.

An improved secondary battery or cell has one or more anodic reaction zones; one or more cathodic reaction zones; a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones; and an electrode which is disposed within the cathodic reaction zone. The improvement comprises employing an electrode, at least a portion of which consists essentially of a porous metal substrate. The substrate is coated, at least in part, with an oxide of a metal selected from the group consisting of metals of Groups I, II, and III of the Periodic Table of elements, Transition Series metals, and tin, lead, antimony, and bismuth to a thickness which is greater than about 500 angstroms, but which results in the electrode portions having a resistivity of less than about 4 ohm-cm^2. The substrate does not fill the entire volume of the cathodic reaction zone, and is, at least in part, adjacent to and contiguous with the cation-permeable barrier. 2 tables.

43056 Accumulator equipped with cathodes of manganese dioxide or lead dioxide. Beck, F.; Wunsch, G.; Treptow, W. (to BASF AG). US Patent 4,079,174. 14 Mar 1978. Priority date 31 Oct 1974, German, Federal Republic of (F.R. Germany). 8p.

Accumulators having solution electrodes containing manganese dioxide and lead dioxide as active material on the cathode side and containing acid electrolytes are discussed. The electrolyte has a content of onium salts soluble in aqueous medium.

43057 Battery wedge for submarines or other installations. Mongillo, A.V. US Patent 4,050,675. 27 Sep 1977. Filed date 6 Oct 1976. 8p.

A wedge assembly for spacing apart batteries, which permits a complete range of operation with all components remaining intact in their assembled form, is provided. A central or inner wedge having a plurality of identical wedge sections is movable between a pair of outer wedges or side plates having mating inner sections and a planar outer surface. Wedging action is produced by torquing a bolt secured to the outer wedges and threaded through a nut secured in the inner wedge. The wedging components are held together and in alignment by screws attached to the inner wedge and guided through slots formed in the outer wedges.

43058 Nickel cadmium cell charger. Roberts, A.P. *Radio Electron. Constr.;* **29**: No. 11, 664-668(Jun 1976).

Rechargeable nickel—cadmium cells are becoming increasingly popular. Because of their low internal resistance they should be charged preferably by constant current sources, and this article describes a unit which is capable of charging up to four "AA" size nickel—cadmium cells.

43059 Luminous indicator for battery condition. *Rev. Esp. Electron.;* **22**: No. 251, 37(Oct 1975). (In Spanish).

The usual difficulty of obtaining adequate battery indication by lamp, due to its relatively high current consumption, is explained. A luminous device which avoids these difficulties is described, and a schematic diagram is given. The indicator is a light-emitting diode connected in series with a Zener diode and a current limiting resistance. As long as the battery voltage is above the Zener diode breakdown level, the light emitting diode is lit. It is extinguished if the voltage drops below this value. A low-potential, good-quality Zener diode is used, and determination of the appropriate resistance is described.

APPLICATIONS

43060 (N—77-32593) Evaluation of battery models for prediction of electric vehicle range. Frank, H.A.; Phillips, A.M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1977. Contract NAS7-100. 67p. (NASA-CR—155045; JPL-PUBL—77-29). NTIS PC A04/MF A01.

Three analytical models for predicting electric vehicle battery output and the corresponding electric vehicle range for various driving cycles were evaluated. The models were used to predict output and range, and then compared with values determined by laboratory tests on batteries using discharge cycles identical to those encountered by an actual electric vehicle while on SAE cycles. Results indicate that the modified Hoxie model gave the best predictions with an accuracy of about 97 to 98% in the best cases and 86% in the worst case. A computer program was written to perform the lengthy iterative calculations required. The program and hardware used to discharge the battery automatically are described.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 42330

43061 Energy - environment - economy. III. The freedom of action. Hoecker, K.H. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). *Atomwirtsch., Atomtech.;* **22**: No. 12, ang p. 2-3(Dec 1977). (In German).

From Energy policies forum of the Landesregierung and the Universitaet Stuttgart; Stuttgart, Germany, F.R. (9 - 12 May 1977).

43062 Energy. The rude awakening. Bailey, R. London; McGraw-Hill (1977). 241p.

This book places UK and world energy problems in perspective. The evolution of UK energy problems are described and it is emphasized that North Sea oil will bring only temporary relief. By the end of the century the UK will probably be importing oil once more. The importance of using this period of economic grace to restructure the economy is stressed. Only in this way will the country be able to face being an oil importer again. Energy forecasts and possible policies to the end of the century are discussed, and the roles of the four main fuels (coal, gas, oil and nuclear energy) are analysed. The social and environmental problems arising from the exploitation of coal and oil reserves, and the further development of nuclear power are considered. An assessment is made of energy prospects for the next century.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 43079, 43127

43063 (BNL—50772) Annual highlights of the National Center for Analysis of Energy Systems. Hoffman, K.C. (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1977. Contract EY-76-C-02-0016. 114p. Dep. NTIS, PC A06/MF A01.

The National Center for Analysis of Energy Systems at Brookhaven has been in operation since January 1976. This annual highlights report outlines the scope of activities of the Center involving the integrated analyses of technological, economic, environmental, and social aspects of energy at the regional, national, and international levels. The objectives of the Center and major accomplishments of 1977 are described along with a list of active projects and publications. The energy data bases and analytical models used in the course of policy analyses are also described. The major ongoing activities of the Center include: long-range forecasting on energy-economic relationships; regional energy and environmental policy; comparative health effects of alternative energy systems; technology assessment and energy R and D priorities; development of energy-economic-environmental models and data bases; R and D strategies for the International Energy Agency; and energy technologies for developing countries.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 43117, 43119, 43120, 43126, 43611, 43612, 43613, 43614

43064 (IA-PW—1) **Some relations involving the use of energy in Israel.** Sonino, T. (Israel Atomic Energy Commission, Tel Aviv). Sep 1977. 31p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The economic development of Israel was studied quantitatively, correlating the gross national product with the energy used, the number of employed persons, and the capital stock. A production function in the form of that of Cobb-Douglass was found, which describes the GNP in terms of these three factors with a very high accuracy. The development of electricity consumption is also examined and correlated to demographic and economic developments.

43065 (MITRE—7591) **Analysis of comprehensive cost-adjustment mechanisms for the utility industry.** Lamb, G.; Freedman, A. (Mitre Corp., McLean, Va. (USA). METREK Div.). Oct 1977. 291p. Dep. NTIS, PC A13/MF A01.

This report reviews the history of comprehensive cost adjustment mechanisms (CCAM) in terms of their advantages and disadvantages as viewed from the perspective of regulated utilities, regulatory commissions, and utility customers. CCAMs are classified by basic form and function. A historical review of more representative CCAMs is employed to assess the impacts of CCAMs on utilities, commissions, and customers over time.

43066 (NMEI—76-172) **Energy resources planning: the social dimensions. Final report.** Blackwell, P.J. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Jan 1978. 83p. New Mexico Energy Inst., Albuquerque.

This study establishes a framework for incorporating social factors in the energy-resources planning-decision process. In addition to technical and economic aspects, decisions must consider social and environmental effects, which are viewed and weighted differently by different interest groups. This paper describes an approach adapted from education and water-resources planning which allows the consumer (lay person) to provide planners with specific information that may be incorporated into the decision process. The social dimensions related to energy-resources planning were delineated using pair comparison and ranking techniques, and the need for the integration of technical planning activities with social concerns is discussed. Decision models to meet those requirements were proposed.

43067 (PB—273490) **An analysis of the contribution of energy price changes to HUD-insured mortgage failures.** Eisen, D.; Williams, J. (Metrostudy Corp., Washington, D.C. (USA)). May 1976. 139p. NTIS PC A07/MF A01.

This study examines the contribution of energy price increases to mortgage failures. Data were collected in files of the U.S. Department of Housing and Urban Development on 551 cases of mortgage failure in four cities. Interviews were held with mortgage servicers in two cities, and data were collected from utilities in regard to average energy price increases over each of the last ten years.

43068 (PB—274957) **Program of statewide transit analysis and technical assistance. Final report.** (Massachusetts Executive Office of Transportation and Construction, Boston (USA)). 30 Jun 1976. 94p. (PUB—9224-86-85-10-76-CR). NTIS PC A05/MF A01.

Contents: Coordination of data concerning capital and operating programming; Statewide coordination of service effectiveness and subsidization projections; Transit analysis in support of environmental and energy conservation responsibilities; Development of statewide transportation services for the elderly and handicapped; Marketing public transit; Summary of transportation technologies -- applicability and cost-effectiveness; Summary of transportation Services for the elderly and handicapped; Recommendations for transportation of special needs children; Evaluation criteria for elderly and handicapped transportation services. (Portions of this document are not fully legible)

43069 (PB—275407) **Awards register. Grants assistance programs. Volume I. Listing awards during the transition quarter (July—September) of FY 1976, except state and local assistance awards.** (Environmental Protection Agency, Washington, D.C. (USA). Grants Administration Div.). Dec 1977. 160p. (EPA/GAD/1—76/005). NTIS PC A08/MF A01.

This publication lists the grant awards offered by EPA during the period of July-September, Fiscal Year 1976, for research, demonstration, training and fellowship programs. A brief project description for most of the research and demonstration grants administered by Headquarters is contained in Section Two, arranged in ascending order of the Grant Identification Number. A Grant Number Index is included to assist cross-referencing into Section One material. Section Three provides a cross-walk for use in identifying the program and sub-program area of a grant. This conversion is based upon classification of programs by the Office of Research and Development and the assignment of Program Element Numbers by their staff. (Portions of this document are not fully legible)

43070 (TID—28526/1) **Planning manual for energy resource development on Indian lands. Volume I. Benefit—cost analysis.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 176p. Dep. NTIS, PC A09/MF A01.

Section II follows a brief introduction and is entitled "Benefit-Cost Analysis Framework." The analytical framework deals with two major steps involved in assessing the pros and cons of energy resource development (or any other type of development). The first is to identify and describe the overall tribal resource planning and decision process. The second is to develop a detailed methodological approach to the assessment of the benefits and costs of energy development alternatives within the context of the tribe's overall planning process. Sections III, IV, and V present the application of the benefit-cost analysis methodology to coal; oil and gas; and uranium, oil shale, and geothermal development, respectively. The methodology creates hypothetical examples that illustrate realistic development opportunities for the majority of tribes that have significant reserves of one or more of the resources that may be economic to develop.

43071 (TID—28526/2) **Planning manual for energy resource development on Indian lands. Volume II. Management and contractual arrangements.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 197p. Dep. NTIS, PC A09/MF A01.

This volume explores options for strengthening tribal control of energy-resource-development activities on their reservations. These options fall into two major categories: improvement of the tribe's internal administrative capability to plan, monitor, and regulate development activities; Part I of this volume addresses how this can be done. Another option deals with stronger and more-explicit contract terms in the development, agreement, and enforcement of those terms; Part II deals with this subject. In order to develop an effective control system, a tribe must be concerned with both of these areas. Contract stipulations will not be effective unless the tribe can ensure that they are enforced. Likewise, in monitoring and regulating company activities, a tribe is in a stronger position if it is backed up by contract terms governing operations on the reservation. The Tribes participating in this study have different levels of managerial capability and technical expertise in the energy field. Their interest in stronger controls on development varies. Therefore, a range of options is suggested.

43072 (TID—28526/3) **Planning manual for energy resource development on Indian lands. Volume III. Manpower and training.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 222p. Dep. NTIS, PC A10/MF A01.

This volume addresses ways to bridge the gap between existing tribal skill levels and the skill levels required for higher-paying jobs in energy resource development projects. It addresses opportunities for technical, skilled, and semiskilled employment as well as professional positions, because it is important to have tribal participation at all levels of an operation. Section II, "Energy-Related Employment Opportunities," covers three areas: (1) identification of energy-resource occupations; (2) description of these occupations; and (3) identification of skill requirements by type of occupation. Section III, "Description of Training Programs," also covers three areas: (a) concept of a training-program model; (b) description of various training methods; and (c) an assessment of the cost of training, utilizing different programs. Section IV concentrates on development of a training program for target occupations, skills, and populations. Again this section covers three areas: (i) overview of the development of a skills training program; (ii) identification of

target occupations, skills, and populations; and (iii) energy careers for younger tribal members.

43073 (TID—28526/4) **Planning manual for energy resource development on Indian lands. Volume IV. The environment.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 165p. Dep. NTIS, PC A08/MF A01.

Many Indian tribes own rich deposits of very valuable energy resources. Existing and proposed uses of these tribal resources range from limited development of small oil and gas fields to large-scale extraction and conversion of coal, uranium, and oil shale. The adverse environmental impacts of such projects may create a conflict between a tribe's environmental policies and its economic, employment, and other long-term goals. The purpose of this volume is to provide tribal decision makers with reference documents on the mechanisms that are available to resolve such conflicts. This report focuses on the role of existing environmental laws in enabling tribes to achieve the needed balance among its objectives. Over a dozen major Federal statutes have been enacted to achieve this purpose. One law, the National Environmental Policy Act (NEPA), provides procedures to ensure that environmental factors are included in the Federal decision-making process. Numerous other laws, such as the Clean Air Act, have been enacted to prevent or control any negative environmental impacts of actual projects. This volume documents the key provisions of the laws and regulations, and discusses their effectiveness in meeting total needs. Also, tribal options to strengthen these mechanisms are highlighted. Sections II and III report on the role of NEPA in tribal development decisions. Section IV reviews those laws and regulations that control project operations.

43074 (TID—28526/5) **Planning manual for energy resource development on Indian lands. Volume V. Energy information and clearinghouse design.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 135p. Dep. NTIS, PC A07/MF A01.

The primary objective of Volume V is to provide a program plan and cost estimate for establishing an Indian Energy Clearinghouse (IEC) for the exchange of information relating to resource development. The initial recommendation is that the IEC also be operated on a manual, not automated, basis. However, this recommendation does not preclude the IEC's accessing other, automated data bases (described in Appendix B). The primary reason for recommending that the system be manual is to provide the IEC with a period of adjustment during which its procedures and services can easily be modified in response to user needs. After this adjustment period (a year or more), the IEC should be reassessed to determine whether computerization is feasible. The development of a system for obtaining user feedback is an essential part of the first-year trial run period. Section II develops a program plan for establishing an Indian Energy Clearinghouse (IEC), while Section III prescribes three alternative models for the IEC. Appendix A reviews in detail the operating characteristics of 12 existing clearinghouses. Finally, Appendix B provides a detailed listing and description of IEC information sources.

43075 (TID—28526/6) **Planning manual for energy resource development on Indian lands. Executive summary.** (Ernst and Ernst, Washington, D.C. (USA)). Mar 1978. Contract EC-76-C-01-8659. 93p. Dep. NTIS, PC A05/MF A01.

This report is the Executive Summary for the other 5 volumes of the Study Report—see TID-28526/1-5. Information is provided here that the tribes can use to make energy-development decisions. The report is particularly concerned with management responsibilities and financial commitments that development will require on the part of the tribes and with the types of information and skilled personnel the tribes will need in the future to make informed decisions.

43076 **Leisure of the theory class.** Laney, R.V. (Argonne National Lab., IL). *Public Util. Fortn.;* **101**: No. 10, 11-13(11 May 1978).

The energy debate is evolving into discussions of how to select options capable of meeting long-range social goals and how to apply the appropriate weight to the various perceptions that underlie individual opinions. The causal relationships linking personal status and attitudes is examined to see if there is a correlation between economic well-being and enthusiasm for a no-growth economy. The affluent U.S. college-educated, primarily concerned with self-actualization, show an inversion of Maslow's hierarchy of needs compared to people in developing countries. They are also in a position to express and promote theories for no-risk technology. The author suggests that these theorists be required to submit the same detailed support for their theories as is required for new energy facilities. The theory class is noted for acting upon faith rather than evidence; for ideas rather than workable plans.

43077 **Expansion of activities of the Saudi Development Fund.** *OAPEC News Bull.;* **4**: No. 4, 19-25(Apr 1978).

Prepared by the Economic Department, OAPEC.

The Saudi Development Fund (SDF), chartered in 1974 for the purpose of granting loans for development projects, has expanded its activities. The loan procedure is outlined and beneficiaries of the 58 loan commitments made by the end of 1977 are listed. The largest share of total loans went for road and railroad construction, followed by electricity, industry, and agriculture. Expansion during 1977, when 53% of the total commitments were made, shifted the emphasis to electricity projects.

43078 **Damping the boom and bust cycle in coastal energy development.** Meade, N. (National Oceanic and Atmospheric Administration, Washington, DC); Hughes, P. *Environ. Data Serv.;* 3-8(Mar 1978).

Data on the economic and social impact of energy facilities on small Western communities was used to develop an economic model for predicting the effects of deepwater ports on small coastal towns and assessing the need for Federal impact assistance. The Assessment of Coastal Energy Development (ASCEND) model is based on systems dynamics over discrete time intervals and uses such real-world circumstances as taxes, employment, and public expenditure levels. The model forecasts conditions that may develop and identifies appropriate options. The model's structure and major assumptions for each of five sections are described. ASCEND analyzes the impacts and interactions of the proposed port facility on economic activity, housing, retail sales and services, public facilities and services, and population movement and projects the effect local and Federal funding options will have.

43079 **Analyzing the world food problem.** de Haen, H. *Options (IIASA);* 1-3(Win 1978).

Basic issues in the global food production and distribution problem are described and some approaches suggested by the International Institute for Applied Systems Analysis (IIASA). Crop failures, high costs and shortages of energy and fertilizers, and inequities of food distribution have all been serious issues of the 1970s. Developing countries will need to set top priority on a high rate of growth for both agricultural and nonagricultural production if the 500 million underfed people are to be nourished. Protection for the European Community needs to be reduced in order to stabilize world markets. Solutions also lie with increased international cooperation to secure food aid on the basis of need rather than commercial profit and in improved international trade of agricultural products. IIASA is developing an international Food and Agricultural Model to help resolve these problems. The model is described along with sample questions and ways of grouping countries.

43080 **Technology transfer through commercial transactions.** Davies, H. (Polytechnic of North London). *J. Ind. Econ.;* **26**: No. 2, 161-175(Dec 1977).

The transfer of technical information to developing countries is more complicated than direct governmental assistance when the knowledge is the private property of a company whose primary concerns are commercial rather than training. How the quality and quantity of assistance related to the company's control over profits is examined in the context of a decision on the part of British companies whether to enter the Indian market. Results of a survey of companies indicates that the companies did not need a superior technical knowledge to gain a monopolistic advantage; that underdeveloped countries may be only marginally interesting to companies competing in advanced world markets; and that efforts on the part of the host country to license or make joint ventures could be disincentives for companies contemplating foreign investment. It was also determined that profit incentives are lacking for companies to adapt to foreign environments if the market is small and can result in less satisfactory factor-substitution. 12 references.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 42134, 43073, 43110, 43132, 43560, 43561, 43566, 43596, 43597, 43598, 43610

43081 **Role of WHO in environmental pollution control.** Shubber, S. (World Health Organization, Geneva). *Earth Law J.;* **2**: No. 4, 363-392(Nov 1976).

The World Health Organization (WHO) considers all aspects of environmental pollution as relevant to its goal of reaching a high level of health for all people. WHO first became involved in environmental pollution in 1948 and has developed programs since to identify, assess, and control sources of pollution in both developing and industrialized countries. Its efforts have focused on various forms of air, food, and soil pollution. A review of its control strategies reveals a potential involvement with international treaties, standards, recommendations, direct assistance (including specific protect implementation and training), and the dissemination of information. The governments of member nations, which must individually decide when to accept a WHO recommendation or proposal, have

not yet adopted a WHO-sponsored treaty or regulation, but member response is expected to improve. 154 references.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 42664, 43066, 43070, 43071, 43072, 43073, 43074, 43075, 43147, 43598

43082 (PB—272983) **Technology assessment of offshore industry. The United States offshore industry. Current status, trends and forecast 1976-2000. Volume I. Final report.** Durfee, J.H. (BDM Corp., McLean, Va. (USA)). Aug 1977. Contract MA-5-38024. 522p. (BDM/W—77-425-TR(Vol.1)). NTIS PC A22/MF A01.

Volume One presents a description of the current status of the U.S. offshore industry together with developing trends in the industry and an examination of the various forces that influence development. A 25 year forecast of offshore industry development is included. Also included is a description of the U.S. commercial ocean fishing industry and a 25 year forecast of industry development.

43083 (PB—272984) **Technology assessment of offshore industry and its impact on the maritime industry 1976-2000. Volume II. Final report.** Durfee, J.H. (BDM Corp., McLean, Va. (USA)). Aug 1977. Contract MA-5-38024. 144p. (BDM/W—77-425-TR(Vol.2)). NTIS PC A07/MF A01.

Volume Two examines the various impacts on the traditional maritime industry of offshore industry development, and describes the areas of planning needed by the maritime industry to accommodate those impacts.

43084 (PB—272985) **Technology assessment of offshore industry and its impact on the maritime industry 1976-2000. Executive summary. Final report.** Durfee, J.H. (BDM Corp., McLean, Va. (USA)). Aug 1977. Contract MA-5-38024. 74p. (BDM/W—77-425-TR). NTIS PC A04/MF A01.

This report contains a 25 year forecast of the offshore industry including offshore petroleum production, offshore power production, offshore mining, offshore service platforms, and commercial ocean fishing. Each segment of the offshore industry is described in terms of the current status of industry, trends that might influence the direction of future development, and forces acting on the industry to impede or encourage growth. The report examines potential areas of impact on the maritime industry, such as financial, manpower, environmental, materials requirements, legislation and regulation, and new technologies, that might result from offshore industry development. Further it discusses changes likely to result in the maritime industry from the various impacts described and suggests planning that will be needed to accommodate to the changes. The report provides a comprehensive analysis of the future of the offshore industry.

43085 (PB—274752) **Mineral industries of western Europe. Mineral perspective report.** Keyes, W.F.; Sondermayer, R.V.; Huvos, J.B. (Bureau of Mines, Washington, D.C. (USA)). Oct 1977. 66p. (BM-MP—4). NTIS PC A04/MF A01.

This report presents a summary of the mineral industries of the nine members of the European Community, the seven members of the European Free Trade association, and three additional countries. Base maps show mineral deposit and mineral processing plant locations for each country. An additional map and photographs on mines, plants, and industries are included. A summary review describes the relative importance of the region as a mineral producer, consumer, importer, and exporter.

43086 Significance of energy for the standard of living, the economic development and the environment. Haefele, W. (Internationales Inst. fuer Angewandte Systemanalyse (IIASA), Laxenburg (Austria)). pp 9 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection; Duesseldorf, F.R. Germany (8 Feb 1977).

After introductory remarks on the present global energy supply situation, the main reasons for the constantly rising energy demand are discussed (development of developing countries, growth in the world population, and growth in the industrial countries), and possibilities are presented to meet this demand by means of new energy sources (nuclear, solar, wind, tidal energy, etc.).

43087 Use and conservation of minerals. Washington, DC; Geological Survey (1977). 7p. GPO $0.50.

Raw materials produced each year by the domestic mineral industry amount to about 4% of the GNP and the manufacturing of mineral products accounts for another 10 to 15% of the GNP. Many conservationists limit their effort to finding the least wasteful method of extracting all of a particular mineral deposit. Another aspect of conservation is the desire of many to enjoy the natural surroundings without interference from man's activities. Competition between the need for minerals and the demand for beauty is resulting in improved mining practices, restoration of mined-out areas, and improved conservation. (MCW)

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 43063, 43108, 43119, 43120, 43121

43088 (AD-A—047073) **U.S. Navy energy research and development program plan FY 1978—FY 1983. Volume 1.** (Tetra Tech, Inc., Arlington, Va. (USA)). Oct 1977. Contract N00014-77-C-0350. 131p. (TETRAT-A—872-77-335(Vol.1)). NTIS PC A07/MF A01.

This document presents a program plan developed to establish a course of action whereby the Director, Navy Energy R and D Office, may effectively carry out the responsibilities of his assigned charter, and to provide the Navy with a structured approach to energy R and D that responds to Navy energy requirements and at the same time complements and becomes an integral part of the national and Department of Defense energy R and D programs. Also discussed in this document is the methodology used in developing the plan, including the selection of goals, strategies and objectives for the Navy Energy R and D program.

43089 (AD-A—047074) **U.S. Navy energy research and development program plan FY 1978—FY 1983. Volume 2. Appendixes.** (Tetra Tech, Inc., Arlington, Va. (USA)). Oct 1977. Contract N00014-77-C-0350. 357p. (TETRAT-A—872-77-335(Vol.2)). NTIS PC A16/MF A01.

Appendixes included discuss: Patterns of Energy Usage in the U.S. Navy; Navy Energy R and D Projects and Progress; Energy Conservation; Synthetic Fuels; Energy Self-sufficiency; Energy-Related Support; Energy Management, Analytical Support, and Funding; and National Energy Research, Development, and Demonstration Programs.

43090 (UTNL-R—0052) **Report of the research results with University of Tokyo, Nuclear Engineering Research Laboratory's facilities in fiscal 1976.** (Tokyo Univ. (Japan). Nuclear Engineering Research Lab.). 10 Sep 1977. 100p. (In Japanese). Dep. NTIS (US Sales Only), PC A05/MF A01.

In Nuclear Engineering Research Laboratory, due to increasing usage of fast neutron source reactor 'Yayoi' as the major joint-use facility, works are performed in 'pillars' for research effectiveness. In fiscal 1976, two additional facilities, linac and nuclear fusion blanket design experimental device were completed. Results of the works in the year are described: shielding benchmark experiment, basic studies in medical irradiation, irradiation experiments, reactor physics, reactivity pulse operation, etc.

43091 1978 ERDA authorization (conservation, high energy physics, and basic energy sciences). Volume II. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, First Session. Washington, DC; Committee on Science and Technology (1977). 216p. GPO.

An overview of the conservation programs of ERDA is presented in the February 22, 1977 hearing. For fiscal year 1978 an authorization for $311.3 million is requested, with an additional $7 million requested for plan and capital equipment. In fiscal year 1978, emphasis on near-term conservation research, development, and demonstration has been increased. The revised fiscal year 1978 request for transportation will support research and development for the Electric and Hybrid Vehicle Act, Public Law 94—413. Funds are also included for the continuation of the energy extension service program. The proposed fiscal year 1978 program will increase the effectiveness of work to improve the efficiency of energy utilization in industrial processes, residential and commercial buildings, and transportation. The request will also permit an increase on work closely with business, industry, universities, as well as Government agencies. Specifically, budgets for three programs were reviewed at the March 2, 1977 hearing—conservation, high-energy physics, and basic energy sciences. (MCW)

43092 Role of the national laboratories in energy R and D. Volume I. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, First Session. Washington, DC; Committee on Science and Technology (1977). 371p. GPO.

The directors of 8 U.S. national laboratories reported their roles in energy R and D. These laboratories, with their 35,000 employees, are part of the foundation of the scientific enterprise in the United States today. Although government-owned, they are privately run and are an example of fruitful cooperation between the private and public sectors. Since their establishment by the Atomic Energy Commission, they have been integrally involved in the development of our nuclear weapon arsenal and of our nuclear

power technology. In recent years they have broadened their roles beyond nuclear energy for the Energy Research and Development Administration and, now, the Department of Energy. Those reporting in two sessions were: Dr. George Vineyard, Brookhaven National Laboratory; Dr. Andrew Sessler, Lawrence Berkeley National Laboratory; Dr. Roger E. Batzel, Lawrence Livermore Laboratory; Dr. Harold M. Agnew, Los Alamos Scientific Laboratory; Dr. Robert G. Sachs, Argonne National Laboratory; Dr. Herman Postma, Oak Ridge National Laboratory; Dr. Tommy Ambrose, Pacific Northwest National Laboratory; and Dr. Morgan Sparks, Sandia Laboratories.

43093 Energy: research, development, and demonstration. Programme of the IEA. Paris; Organization for Economic Cooperation and Development (1977). 24p.

The objectives of the IEA's energy research, development, and demonstration activities are to develop a strategy for energy R and D, foster effective national programs of energy R and D, and undertake cooperative energy research, development, and demonstration projects in high-priority areas. The Working Party (designated to develop R and D cooperation) is composed of 14 working bodies. They deal with energy conservation technology; coal technology; safety, radioactive wastes, and high-temperature reactors for process heat (nuclear power); geothermal energy; heating and cooling of buildings and electric power generation (solar energy); biomass conversion; ocean energy systems; wind power; fusion power; and hydrogen production from water. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 42183, 42329, 42663, 42674, 42826, 42828, 42829, 42830, 42951, 42975, 43024, 43042, 43118, 43121, 43135, 43136, 44013

43094 (N—78-11896) **Technology assessment in a dialectic key.** Majone, G. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Jan 1977. 37p. (IIASA-PP—77-1). NTIS PC A03/MF A01.

Technology and institutions interact dialectically. Institutional factors affect the range of alternatives considered by innovators, the resolution of disputes over the consequences of innovation, and even the efficiency of technical projects. Thus, technological impacts are determined in the arena of institutional choice just as much as in the laboratory and on the drawing board. Examples from the fields of medical care, nuclear power generation, and broadcasting technology are used to illustrate this interdependence. Dialectic thinking, in the Greek sense of a systematic critique of assumptions, arguments, and conclusions, is necessary to counteract institutional and conceptual biases and to support unconventional approaches. As the current interest in adversary proceedings and other dialectic modes of discourse shows, the narrow paradigm of decisionism is being replaced by quasi-jurisprudential methods for assessing the adequacy of arguments, the strength of evidence, and the intrinsic limitations of technical solutions.

43095 (PB—272857) **Overview of nuclear export policies of major foreign supplier nations.** (General Accounting Office, Washington, D.C. (USA). International Div.). 21 Oct 1977. 66p. (ID—77-60). NTIS PC A04/MF A01.

The United States faces increased competition from foreign nuclear suppliers, including West Germany, France, the United Kingdom, Canada, and possibly, in the near future, Japan. This general overview shows the differences and similarities in foreign nuclear supplier export requirements. It is based on summaries furnished by the Department of State covering the nuclear export policies and procedures of the major foreign supplier nations.

43096 (Y/OWI/SUB—78/22336) **Resolving community conflict in the nuclear power issue: a report and annotated bibliography.** Burt, R.S.; Fischer, M.; Corbett, T.; Garrett, K.; Lundgren, M. (California Univ., Berkeley (USA). Dept. of Sociology). Feb 1978. Contract W-7405-ENG-26. 193p. Dep. NTIS, PC A09/MF A01.

This report is a scholarly discussion of the escalation and possible resolution of community conflict in the nuclear power issue. The concern is at all times with the social factors in this conflict; technical problems in nuclear power are only considered to the extent that such problems are raised in conflict over nuclear power. Social science research on conflict is only reviewed to the extent that it bears on community conflict over nuclear power. Chapter 1 describes the nature of community conflict escalation in the nuclear power issue: stages of escalation, typical individuals and groups involved, typical issues raised, typical manners in which participants become involved, and the basic social parameters of conflict escalation. Chapter 2 outlines the community level determinants of conflict escalation in the nuclear power issue: How is a community in which conflict over a nuclear facility is most likely different from a community in which such conflict is least likely. Chapter 3 is a detailed consideration of alternative methods of containing and resolving conflict. Chapter 4 summarizes principles for dealing with community conflict in the nuclear power issue. Finally, Chapter 5 is an annotated bibliography of the literature reviewed in the report. 840 references.

43097 High cost of nuclear power plants. Bassett, C. *Public Util. Fortn.;* **101**: No. 9, 29-35(27 Apr 1978).

Retroactive safety standards were found to account for over half the costs of a nuclear power plant and point up the need for an effective cost-benefit analysis of changes made by the Nuclear Regulatory Commission after construction has started. The author compared the Davis-Besse Unit No. 1 construction-cost estimates with the final-cost increases during a rate-case investigation in Ohio. He presents data furnished for ten of the largest construction contracts to illustrate the cost increases involving fixed hardware and intensive labor. The situation was found to repeat with other utilities across the country even though safeguards against irresponsible low bidding were introduced. Low bidding was found to continue, encouraged by the need for retrofitting to meet regulation changes. The average cost per kilowatt of major light-water reactors is shown to have increased from $171 in 1970 to $555 in 1977, while construction duration increased from 43.4 to 95.6 months during the same period.

43098 Nuclear power and nuclear-weapons proliferation. Moniz, E.J.; Neff, T.L. (Massachusetts Inst. of Tech., Cambridge). *Phys. Today;* **31**: No. 4, 42-47(Apr 1978).

The material presented in this article attempts to clarify the basic technical and political issues that are being debated in the contest between breeder reactors to insure abundant energy with possible resulting proliferation and the questionable continuation of uranium-fueled reactors with possible future availability of uranium. The connection between various fuel cycles and their possibility for proliferation are discussed. (BLM)

43099 Nuclear power: a perspective of the risks, benefits, and options. Flowers, B. (Imperial Coll. of Science and Tech., London). *Bull. At. Sci.;* **34**: No. 3, 21-26, 54-57(Mar 1978).

An assessment of potential risks, benefits, and options available with nuclear power concludes that a complete withdrawal is both unnecessary and impractical for the near-term. The speed with which alternative technologies, conservation programs, and global cooperation develop will determine how long nuclear power remains the best option. The author reviews the role of fast breeder reactors, characteristics of the plutonium cycle, hazards and strategies of handling radioactive wastes, threats of proliferation, problems of mining and enriching uranium, and the international-trade implications of energy resources. He concludes that each country is acting from a nationalistic point of view and recommends a global policy, along the lines of President Carter's, of slowing nuclear technology until effective international security and safety controls are developed.

43100 Nuclear Non-Proliferation Policy Act of 1977. Hearings before the Subcommittee on Energy Research and Development of the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on S. 897 and S. 1432. Washington, DC; Committee on Energy and Natural Resources (1978). 227p. GPO.

On April 7, 1977, President Carter announced his nuclear power policy. The policy statement set forth seven specific objectives for the future use of nuclear energy in this country and the rest of the world. The two proposed instruments for implementing this policy are the revised fiscal year 1978 ERDA authorization draft bill and S. 1432, the Nuclear Non-Proliferation Act of 1977. These legislative proposals are linked in that S. 1432 is designed to establish a non-proliferation framework with specific objectives established for the ERDA nuclear energy programs. The ERDA authorization bill is the budgetary vehicle to implement those objectives. The Committee on Energy and Natural Resources obtained joint referral of certain portions of the Nuclear Non-Proliferation Act to insure that non-proliferation policy is implemented in a manner consistent with the policy of having sufficient energy for this country and foreign countries in the future. The Subcommittee on Energy Research and Development must examine the costs and the consequences of various initiatives before they are implemented. F or example, the proposal to guarantee uranium enrichment services for foreign nations poses specific requirements on ERDA to expand considerably our enrichment capacity by the year 2000. Without reprocessing, it is expected that spent fuel rods from abroad will be returned to this country for storage with attendant costs and siting decisions. Also, international fuel-cycle evaluation programs must be carefully examined to insure that all options, including regional fuel cycle centers with international controls and inspection, are considered in seeking international approaches to the non-proliferation objectives. At the June 10 hearing, the subcommittee received testimony on S. 1432, the bill prepared by the administration. The

hearings on September 13 and 14 focused on S. 897. Statements by many witnesses are included. (MCW)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 43421

43101 (PB—274930) **Combined truck/rail transportation service: action needed to enhance effectiveness. Report to the Congress.** (General Accounting Office, Washington, D.C. (USA). Community and Economic Development Div.). 2 Dec 1977. 48p. (CED—78-3). NTIS PC A03/MF A01.

Methods that the Interstate Commerce Commission may use to encourage the growth of piggyback transport and to increase transportation efficiency are presented. The problems railroads have and how the Interstate Commerce Commission, within its statutory authority, can help alleviate them are discussed.

43102 **Commercial thermal energy storage for electric load leveling.** Heitner, K.L.; Moritz, P.S. (TRW, Inc., McLean, VA). *Public Util. Fortn.;* **101**: No. 10, 24-27(11 May 1978).

Data are presented that indicate a commercial market potential for thermal energy storage (TES) water-heating and air-conditioning systems. A market analysis of commercial loads and utility service area data indicates that areas with a time-of-day rate differential of one or two cents would find TES systems economical and TES equipment cost-effective. The incremental capital costs for commercial hot water and air conditioning systems are compared for a range of capacities. TES hot-water systems are found to be more viable with a small discharge time, while TES air conditioning is most economical in very large systems. Utilities still lack enough awareness and experience with TES to recognize their commercial value.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 42476

43103 **Investigation into the use of large-scale total-energy systems in mild and warm climates.** Reale, F.N.; Dillon, T.S. *Fuel;* **56**: No. 3, 257-265(Jul 1977).

One way to increase efficiency of energy use is by the total-energy system, using waste heat from electric power generation for district heating. A large system using fully-proven conventional technology is preferable. Energy and economic aspects of such a system fuelled by brown coal or briquettes in an idealized city of 100,000 in southern Australia are reported. Heat is supplied by the extraction turbine system using steam turbines. Hot water is the heating medium. Two circuits are envisaged, one supplying low-grade commercial and residential heat at 150 C, the other supplying industrial areas at 230 C. Detailed analyses of efficiencies, time distribution of load, and sensitivities of costs to electrical load and fuel prices are given. The system is economically attractive in mild climates and could reduce energy costs to consumers by about 50% while increasing the efficiency of energy use in electric power generation.

CONSERVATION

REFER ALSO TO CITATION(S) 42651, 43091, 43119, 43120, 43165, 43166, 43167, 43173, 43176, 43189, 43194, 43205, 43206

43104 (FEA/D—77/258) **Energy efficiency improvement targets in the machinery (except electrical) industry: SIC 35. Volume 3. Final target document.** (Kearney (A.T.), Inc., Chicago, Ill. (USA)). Jan 1977. Contract EM-76-C-01-8626. 132p. Dep. NTIS, PC A07/MF A01.

In accordance with section 374 of the Energy Policy and Conservation Act (EPCA), P.L. 94-163, the Federal Energy Administration proposed industrial energy-efficiency-improvement targets for the ten most energy-consumptive manufacturing industries in the United States, and invited the oral and written presentation of views thereon by interested persons. Following public hearings and review of the written comments which were submitted to FEA, the final targets for machinery (except electrical) (Standard Industrial Classification 35) have been developed and are described in this report. They are intended to provide the basis for conservation activities undertaken in furtherance of the industrial energy conservation program.

43105 (HCP/M50217—01) **Energy efficiency and electric motors.** (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Apr 1978. 173p. Dep. NTIS, PC A08/MF A01.

The Edison Electric Institute and the Department of Commerce reported that, in 1972, the commercial and industrial sectors of the U.S. economy consumed about 920 billion kWh of electrical energy. Of this, about 60 percent was used to power electric motors in industrial and commercial process equipment. The underlying hypothesis of this investigation is that efficiency ratings are not being given proper consideration in the selection and purchase of electric motors. Specifically, it is proposed that a life-cycle cost analysis from the user's point of view may often dictate the selection of more-efficient, albeit more-expensive, models. It is further proposed that, for particular pieces of equipment, efficiency standards may be established in the name of energy conservation without unreasonably affecting equipment performance or cost. This study concerned 5 tasks. Task I, equipment characterization, was concerned with standard and built-in electric motors applied to commercial and industrial process equipment and included AC single-phase and AC polyphase (squirrel-cage, wound-rotor, synchronous); and DC (shunt-wound, series-wound, compound-wound). Task II, Market characterization, identified the basis of motor choice by users. Task III traced the historical progression of motor efficiencies and projected future trends. Task IV assessed technological and economical constraints, while Task V developed policy option scenarios.

43106 (PB—275687) **KCMR Dial-A-Ride study: Report No. 2. Dispatching and communications.** (Mid-America Regional Council, Kansas City, Mo. (USA); Bishop Engineers, Inc., Kansas City, Mo. (USA)). Apr 1977. 33p. NTIS PC A03/MF A01.

This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. Report No. 2 describes the dispatching and communication requirements for small Dial-A-Ride systems, such as the small pilot system in Independence, Missouri, and for a large integrated system, such as the one proposed for Northeastern Johnson County, Kansas. The report presents operating procedures and design and cost considerations for the equipment of the systems, as well as a glossary of radio terminology. It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium- and lower-density suburban areas.

43107 (SRC-TR—77-595) **Adoption and utilization of energy conservation in local government: a decision-making study.** Lambright, W.H. (Syracuse Research Corp., N.Y. (USA)). Dec 1977. Contract EY-76-C-02-4044. 183p. Dep. NTIS, PC A09/MF A01.

This report investigates the manner in which the local governments of two medium-size cities in New York State, Rochester and Syracuse, have sought out innovative energy technologies to mitigate local public-service-delivery problems brought about by the impact of the energy crisis. The focus is on energy conservation and energy policies within local governmental agencies. The reasons for undertaking such a study are twofold. First, local governments are significant energy users in their own right, and their capacity to deal with impacts of the energy crisis may have a significant bearing on their future ability to meet public service demands. Second, the process by which energy users acquire new energy-saving technologies—or technology transfer—may be substantially different when the end user is the local-government sector. Achieving commercialization, or widespread usage, of energy-efficient technologies in urban public functions may follow a process distinctly different than that found in technology transfer to the commercial, residential, or industrial sectors. Insight into how local governments view this acquisition of energy-efficient technological innovations could provide valuable understanding to both Federal and state policy makers, and to manufacturers considering urban markets for energy technologies. 28 footnotes.

43108 **Fuel conservation and applied research.** Grey, J. (American Inst. of Aeronautics and Astronautics, New York); Sutton, G.W.; Zlotnick, M. *Science;* **200**: No. 4338, 135-142(14 Apr 1978).

The critically important role of applied research has been identified in a number of specific past, present, and future activities related to fuel conservation. The importance of applied research generally tends to go unrecognized as compared with basic research and product development processes, not only in fuel conservation activities but in virtually every area of technology implementation. There are well-defined roles for both government and industry in the effective utilization of applied research, and the engineering societies offer a potentially effective existing framework for government and industry to implement these roles. 21 references.

43109 Mandatory energy conservation amendments to President Carter's energy program. Hearings before the Subcommittee on Energy Conservation and Regulation of the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on the proposed mandatory energy conservation amendments to S. 1469. Washington, DC; Committee on Energy and Natural Resources (1978). 752p. GPO.

The witnesses at the July 25, 1977 hearing believe the proposed amendments examined could save more than 1 million barrels of oil per day without raising the price of energy 1 cent. These proposals are the result of discussions with the Congressional Research Service of the Library of Congress, the Congressional Budget Office, the Office of Technology Assessment, energy related industries, several private energy consultants, and the Administration. They should not be considered the final word on conservation, but as a first step in an area where much greater emphasis is needed. The first proposal attempts to reduce the energy lost by inefficient home-heating units. The second amendment would establish efficiency test procedures and minimum-efficiency standards for electric motors and pumps. According to the FEA, this proposal could save as much as 165,000 barrels of oil per day. The third amendment would establish a minimum fuel economy standard for automobiles beginning in 1980. Starting with a figure of 20 miles per gallon, and rising to 27.5 miles per gallon by 1985, this amendment would prohibit manufacturers from selling cars that did not meet these standards. By eliminating the gas guzzler from the market, anywhere from 127,000 to 350,000 barrels of oil per day could be saved. The fourth amendment would merely require the installation of radial tires and demand-actuated electric cooling fans on certain classes of new trucks. The last proposal is designed to encourage the reuse and recycling of beverage containers by requiring a five cent deposit on bottles and cans. The hearing on July 26, 1977 continued the examination of the 5 proposals while the hearing on August 1, 1977 dealt only with minimum standards for automobiles in the U.S. (MCW)

43110 Status of Federal energy conservation programs. Part 2. Hearing before the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on the progress achieved by Federal programs aimed at increasing the efficiency on energy use in the United States and the potential for further improvements in energy efficiency through additional legislation. Washington, DC; Committee on Energy and Natural Resources (1977). 995p. GPO.

The Subcommittee on Energy Conservation and Regulation held its second hearing on the status of Federal energy conservation programs on April 6, 1977. Federal departments and agencies reported who are responsible for energy conservation programs described in existing law (Energy Policy and Conservation Act, Energy Conservation and Production Act, etc.). Energy conservation programs in the Department of Commerce, Department of Transportation, ERDA, FEA, and HUD are summarized. Spokespersons from the Sierra Club and the National Governors' Conference also presented statements. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 43066, 43082, 43083, 43084, 43116, 43117, 43679

43111 (PB—245382) **Energy supply planning model. Volume I. Model structure and use. Final report, December 1973—August 1975.** Carasso, M.; Gallagher, J.M.; Sharma, K.J.; Gayle, J.R.; Barany, R. (Bechtel Corp., San Francisco, Calif. (USA)). Aug 1975. Contract NSF-C867. 244p. (NSF—10900-II-1). NTIS PC A11/MF A01.

In late 1973, a growing national perception of the degree of U.S. dependence on foreign oil supplies stimulated the proposal of several U.S energy policies. These policies were generally aimed at reducing, or at least varying, demand for specific energy forms and devising different schemes to supply sufficient energy from domestic resources at the earliest possible data. To compare and evaluate these proposals, a means was desired for converting the proposed policies into strategies and programs that would establish, primarily, 'critical path facilities' and, in so doing, would make possible judgements on the feasibility of the proposed policies. After some reflection on the complexities of an undertaking of this kind, it was decided to generate a consistent means of converting proposed U.S. energy supply policies to annual schedules of facilities and the capital, manpower, and material resources required to bring them on-line. This, it was believed, would constitute the first step toward determining the feasibility of proposed policies. This report documents the study. The structure and function of the Energy Supply Planning Model are described and its use illustrated. Both the modeling effort and the development of the supporting data base are at a point where the model may be used intelligently for energy supply planning.

43112 (PB—245383) **The energy supply planning model. Volume II. User's manual and appendices. Final report, December 1973—August 1975.** Carasso, M.; Gallagher, J.M.; Sharma, K.J.; Gayle, J.R.; Barany, R. (Bechtel Corp., San Francisco, Calif. (USA)). Aug 1975. Contract NSF-C867. 331p. (NSF—10900-II-2). NTIS PC A15/MF A01.

The specific modeling work reported here was stimulated by the need to explore the feasibility of proposed U.S. energy policies in terms of the requirements for specific societal resources associated with the construction and operation of energy supply and energy transportation facilities needed to implement these energy supply policies. The Energy Supply Planning Model is designed to covert future (1975 to 1995) energy mixes to resource requirements schedules. With this planning tool, the feasibility of various proposed mixes can be assessed in terms of the time, capital, manpower, materials, and construction schedules required for the specified energy supply system. In carrying out the modeling efforts, special emphasis was placed on developing a rather transparent planning model where the user can test the implications of different energy policy options.

43113 (PB—275371) **Energy contingency planning. Study Module No. 4 (final).** Menegakis, D. (Northwest Energy Policy Project, Portland, Oreg. (USA); Little (Arthur D.), Inc., Cambridge, Mass. (USA)). 1977. 390p. NTIS PC A17/MF A01.

This report discusses the issues associated with the supply of major energy sources - electricity, natural gas, petroleum; the legal and administrative environment within which energy contingency planning can be performed; technical aspects of action plans or contingency measures - list of measures, energy savings and economic impact; and, the energy shortage measurement and triggering issues.

43114 No way for less energy. McCormack, M. (House of Representatives, Washington, DC). *Public Util. Fortn.;* **101**: No. 9, 17-20(27 Apr 1978).

Congressman McCormack assumes the most-optimistic projections for conservation as a substitute for energy consumption and the most-optimistic projections for the contribution of new technologies for meeting the nation's total energy demands; yet he concludes that it will be necessary to increase domestic energy production from conventional sources of oil, natural gas, and nuclear power to maintain economic stability and prevent a sharp decline in the American standard of living between now and the year 2000. While he sees nuclear power and natural gas as the only two flexible and significant sources of energy, he stresses the need to support every promising technology with imaginative research and development projects.

43115 U.S. energy demand: some low energy futures. *Science;* **200**: No. 4338, 142-152(14 Apr 1978).

The basic features of the U.S. energy supply and utilization system change so slowly that an understanding of the dynamics of major change requires projections that extend several decades. Over such a time most energy-consuming capital stock is replaced, life styles change, and technology evolves. This study of plausible low-energy futures leans heavily on detailed engineering analysis of demand by sector, combined with econometric techniques where appropriate. The results indicate that, given time for the system to respond to prices, regulations, and incentives, U.S. energy demand is very elastic. Consequently, a major slowdown in demand growth can be achieved simultaneously with significant economic growth by substituting technological sophistication for energy consumption.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 42221, 42329, 42414, 42420, 42604, 42829, 43076, 43079, 43080, 43095, 43109, 43111, 43112, 43114, 43133, 43134, 43176

43116 (ORNL/TM—6233) **Critique of Amory Lovins' soft energy path.** Simard, R.L. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 44p. Dep. NTIS, PC A03/MF A01.

Our current energy policy is characterized by Amory Lovins as relying upon the rapid expansion of centralized "hard" technologies to increase supplies of energy, especially in the form of electricity: it is criticized for diverting large amounts of capital from other sectors of the economy, imposing undesirable life styles upon energy users, and enhancing the proliferation of nuclear weapons. An alternative policy is offered by Lovins that relies upon diverse, renewable energy sources. These "soft" technologies are characterized as more-flexible and less-complicated than the hard technologies

and as better matched in scale and energy quality to end-use needs. Combined with conservation and technical fixes to improve efficiency and reduce overall demand from current projections, these systems are to supply all domestic energy needs by the year 2025. Lovins' scenario has been reviewed by three consulting groups under subcontract to Oak Ridge National Laboratory; their opinions are summarized herein.

43117 (PB—273148) **Analysis of the proposed National Energy Plan.** (Office of Technology Assessment (U.S. Congress), Washington, D.C.). Aug 1977. 240p. (OTA-E—51). NTIS PC A11/MF A01.

This report analyzes the proposed National Energy Plan submitted to the Congress by the Carter Administration in April, 1977. The study evaluates the Administration's proposals and their technical, environmental, social, and economic impacts. These are grouped according to the Plan's impacts on energy supply, energy demand, and society.

43118 **Energy and technological policy: the House view.** McCormack, M. (House of Representatives, Washington, DC). *IEEE Trans. Ind. Appl.;* **IA-14**: No. 1, 9-15(1978).

Rep. McCormack reviews the correlation of energy supplies with national, political, and economic security as it relates to the development of a rational and responsible national energy policy. He emphasizes that, while no system is foolproof, it is important to develop all options because the nation's total energy consumption must increase in spite of conservation efforts and a reduced growth rate. He points out that heavily funded research alone will not bring a quick solution to meeting future energy demand. Solar and geothermal energy, for example, can only contribute four to six percent of total demand by the year 2000, while conservation programs were not adequately funded. This leaves nuclear energy as the most environmentally sound and reliable energy available. He feels that while President Carter's efforts to reduce nuclear weapons proliferation are commendable, the assumptions on which Carter made his decisions are not valid. These assumptions are analyzed and the case made for developing breeder technology.

43119 **ERDA Fiscal Year 1978 authorization. Part 1. Hearings before the Subcommittee and Energy Research and Development of the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on S. 1340, S. 1341, and S. 1811.** Washington, DC; Committee on Energy and Natural Resources (1978). 1047p. GPO.

March 7, 1977 was the first day of the hearings before the Subcommittee to examine the fiscal year 1978 ERDA authorization request. President Carter's revised budget request for ERDA reduced the original budget submitted by the Ford administration by $87 million in budget authority and $39 million in budget outlays. The revised budget provided additional authorizations for such near-term energy R and D programs as energy conservation, solar heating and cooling, and increased utilization of fossil fuels through development of such near-term technologies. A quarter of a billion dollars were shifted from longer-range, higher-risk programs like fusion, the fast-breeder reactor, and solar electric and transferred to programs such as energy conservation, solar heating and cooling, and fossil fuel. Significant items retained in the revised budget include $300 million in budget authority for an alternative fuels demonstration program, and $8 million in budget authority for continuation of the "Energy Extension Service". The second session, March 9, 1977, includes testimony about ERDA programs dealing with environment and safety, and physical research. The Mar. 17 hearing on geothermal and solar energy was conducted for the purpose of bringing the subcommittee up to date on the Government programs. Energy conservation is felt to be the least disruptive to increase energy supplies; this was examined during the Mar. 22 hearing. Testimony was received on Mar. 23 about development of technologies to recover oil left in the ground, natural gas trapped in shale and tight-rock formations, projects to utilize our Nation's vast coal and oil shale deposits. The session on Mar. 24 heard testimony dealing with nuclear energy development. (MCW)

43120 **ERDA Fiscal Year 1978 authorization. Part 2. Hearings before the Subcommittee on Energy Research and Development of the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on S. 1340, S. 1341, and S. 1811.** Washington, DC; Committee on Energy and Natural Resources (1978). 2116p. GPO.

The Subcommittee, previously having heard from government witnesses on geothermal and solar energy programs, received testimony on March 25, 1977 from witnesses from industry that are actively engaged in development of solar and geothermal energy. The hearing on Mar. 28, permitted testimony by witnesses on the nuclear energy programs of ERDA in the context of the proposed 1978 ERDA budget. Continuing the hearings to consider the fiscal year 1978 ERDA authorization request, the April 4 hearing dealt with energy conservation and the nation's ability to become a less-energy-wasteful nation; statements on these subjects came from participants from industry. Senator Melcher from Montana urged the approval of a $125 million authorization for MHD in fiscal year 1978 at the April 5 hearing. The subcommittee on April 19 heard testimony on the ERDA nuclear fusion programs and controlled thermonuclear fusion research. On June 8, hearings were resumed on the nuclear energy portion of the authorization bill. In the final hearing in this series on June 9, 5 experts debated the technical merits of the ERDA nuclear energy program as previously structured and now restructured as proposed by the President. (MCW)

43121 **1979 Department of Energy authorization. Volume III. Nuclear energy research. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, Second Session.** Washington, DC; Committee on Science and Technology (1978). 981p. GPO.

On February 2, 1978, Dr. Eric Willis, in an opening statement to consider the 1979 DOE authorization budget on nuclear energy reviewed first the department's overall policy on nuclear energy. He then presented to the Committee on Science and Technology, House of Representatives, what the Department of Energy sees as priorities in the nuclear area. First, is the radioactive waste issue; then the emphasis is on light water reactor technology. He cites the fact that the budget request is predicated on cancellation of the Clinch rRiver project. It is estimated that $200 million will be required for termination and completion of the system design. Statements from other experts in the nuclear field are included. The topics for the Feb. 7 session included magnetic and laser fusion, advanced reactor concepts, advanced fuel cycle concepts, and nuclear physics. Again, Dr. Willis was the initial speaker. The Feb. 8 session consisted of many testimonies from nuclear science experts and covers all aspects of nuclear energy. (MCW)

43122 **Energy policy, strategies for uncertainty.** Cook, P.L.; Surrey, A.J. London; Martin Robertson (1977). 240p.

The subject is dealt with in chapters, entitled: energy policy-objectives, strategies and policies; the 1967 fuel policy; problems of the optimizing approach; the uncertain outlook; oil; coal; gas; electricity; the interdependence of the four fuel industries; energy policy for the future - the need for a long-term strategy; medium-term strategies and short-term policies; the organizational decisions of energy policy. Nuclear power is included in the subject matter.

43123 **Energy: the rude awakening.** Bailey, R. Grand Rapids, MI; Energy Education Publishers (1977). 255p. $12.95.

The 1973 to 1974 oil-price revolution and the rise of OPEC completely changed the position of oil in international trade and greatly increased the value of every country's indigenous resources. Governments are finding it difficult to arrive at coherent energy policies in view of the mass of forecasts and plans that has to be reconciled, the conflicting interests of different fuel authorities, and the often-unrealistic policy priorities of political parties. Mr. Bailey describes the evolution of UK energy problems and emphasizes that North Sea oil will bring only temporary relief. By the end of the century the UK will probably be importing oil once more. He stresses the importance of using this period of economic grace to restructure the economy. Only in this way will the country be able to face being an oil importer again. Energy forecasts and possible policies to the end of the century are discussed, and the roles of the four main fuels (coal, gas, oil and nuclear energy) are analyzed. The author also considers the social and environmental problems arising from the exploitation of coal and oil reserves and the further development of nuclear power. In an epilogue he scans the future and makes an assessment of energy prospects for the next century.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 42211

43124 (PB—274541) **Advanced fossil fuel and the environment: an executive report.** Dorset, P.; Myers, D.; Parker, T.; Laska, R. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1977. Contract EPA-68-01-2940. 30p. NTIS PC A03/MF A01.

This executive-level report gives an overview of some of the more advanced fossil fuel technologies, including several Chemical Coal Cleaning and Liquid Fuels Cleaning methods. Synthetic fuels, Chemically Active Fluid Beds, and Oil Shale are also considered as viable advanced processes and control technologies. The overview includes a discussion of these processes, state-of-the-art, and environmental impacts which are being, or have been, investigated. (Color illustrations reproduced in black and white)

43125 **Norwegian oil and gas policy.** Gjerde, B. (Minister of Oil and Energy in Norway). *OAPEC News Bull.;* **4**: No. 4, 32-46(Apr 1978).

Paper presented to Petroleum Policy and Decision Making Seminar, Sanderstolen, Feb. 6—11, 1978.

The Norwegian Minister of Oil and Energy explains the importance of integrating petroleum policy into the broad political picture because of Norway's economic situation. Since oil was found on the continental shelf 13 years ago, changes have been made in projected production levels to reflect the international recession and concerns over unemployment in Norway. Policies are aimed at keeping a constant activity in the petroleum sector through allocation of particular block development that will improve continental shelf mapping and encourage new deepwater exploration and development. He outlines licensing criteria and future exploratory activities. The report covers aspects of safety, transportation, and landing and the impacts of petroleum activities on Norwegian communities.

COAL

REFER ALSO TO CITATION(S) 42134, 42183, 42189, 42218, 42219, 42221, 42222, 43421

43126 (PB—273493) Implications of a doubling of Kentucky coal production for the state economy. Hultman, C.W.; Davis, B.; Ramsey, J.; Marsden, J. (Kentucky Univ., Lexington (USA). Coll. of Business and Economics). Jul 1977. 67p. NTIS PC A04/MF A01.

This study examines the nature and magnitude of benefits and cost that would occur in Kentucky economy if the output of coal in Kentucky would double in 8 to 10 years. The cost benefit analysis is conducted for three separate scenarios, each representing a different composition of demand for four categories of coal consumption: export; electric utilities; industry, commerce and household; and coal conversion to gas or liquid. The study includes the major impact on the coal mining industry, coal supportive industries, coal conversion, population, employment, local and state revenue, social infrastructure and cost related thereto, and the environment.

43127 Looking into the coal option. Grenon, M. *Options (IIASA);* 5-6(Win 1978).

A report on the 1977 Energy Resources Conference held in Moscow focuses on the technical and economic aspects of coal as they relate to global resource policy problems. Estimates of untouched reserved continue to rise, including those in developing countries, although the Soviet Union, China and the U.S. continue to dominate. Underground mining will be applied, with new approaches in hydraulic bore hole mining, robots, microbiological attack, in-situ liquefaction, underground gasification, and others being explored and developed. Surface mining is expected to account for most of the increased production in the near term with equipment that tends toward gigantism. The major issue with coal, however, is its dependence on inexpensive transportation and the possibility of using pipelines. The conference reviewed the role of coal in meeting increasing energy demand and concluded that power generation and metallurgical applications will absorb the increase in production. Combustion products and their effects on global climatic and atmospheric conditions were discussed with the consensus that more work is needed to quantify carbon dioxide risk.

PETROLEUM

REFER ALSO TO CITATION(S) 42230, 42242, 42243, 42244, 42262, 42263, 42264

43128 Department of Energy Naval Petroleum Reserves. Hearing before the Subcommittee on Military Construction and Stockpiles of the Committee on Armed Services, United States Senate, Ninety-Fifth Congress, First Session. Washington, DC; Committee on Armed Services (1978). 103p. GPO.

The oil reserves and oil shale deposits from the Department of the Navy were transferred to the Department of Energy. They represent the only producing oil fields under Federal control, and the oil-shale reserves are among the richest of any such lands in the U.S. Immediately prior to the enactment of the Naval Petroleum Reserves Production Act of 1976, the naval petroleum reserves were produced only in such amounts as were necessary for the protection, conservation, maintenance, and testing of such reserves. When Congress passed Public Law 94—258, it mandated that NPR Nos. 1, 2, and 3 be produced at the maximum efficient rate, consistent with sound engineering practices, for a period of 6 years. Presently, the maximum production rate of NPR No. 1, which is Elk Hills, averages approximately 101,000 bbl/day due primarily to gas-handling constraints. It is estimated that at full development the maximum efficient rate of crude oil production from Elk Hills, assuming current production levels, will be approximately 300,000 bbl/day following completion of the pipeline, gas-handling facilities, and other production facilities. The U.S. receives a royalty share of production from NPR No. 2 lessees. This reserve is essentially developed and producing at its maximum rate of production of approximately 8,300 bbl/day at this time. The U.S. royalty share of this production is roughly 400 bbl/day. At Naval Petroleum Reserve No. 3, near Casper, Wyo., current production is approximately 1,000 barrels of oil per day. As this reserve's development program progresses, it is estimated that some 4,000 bbl/day will be produced by the end of 1977.

43129 Strategic Petroleum Reserve Plan. Printed at the request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, United States Senate, Ninety-Fifth Congress, First Session. Washington, DC; Committee on Interior and Insular Affairs (1977). 379p. GPO.

In the Energy Policy and Conservation Act (P.L. 94-163), the 94th Congress authorized the creation of a Strategic Petroleum Reserve of up to one billion barrels of crude oil and petroleum products. The Act required the Administrator of the Federal Energy Administration to submit to the Congress by December 15, 1976 a Strategic Petroleum Reserve Plan detailing his proposals for "designing, constructing and filling the storage and related facilities of the Reserve." To place that Plan in perspective, the introductory section identifies the events leading to the creation of the SPR, summarizes the enabling legislation, and discusses the relationship of the Early Storage Reserve (ESR) to the Strategic Petroleum Reserve. The chapters that follow are: An overview; Size of Reserve; Petroleum Products; Identifying, Selecting, and Developing Storage Facilities; Storage for Regional Petroleum Reserve and Noncontiguous Areas; Industrial Petroleum Reserve; Distribution Plan; Implementation of the Plan; Cost of the Strategic Petroleum Reserve; Economic Impacts of Establishing the SPR; and Environmental Assessment. Much additional information on the plan is presented in appendices. (MCW)

NATURAL GAS

REFER ALSO TO CITATION(S) 42243, 42244

43130 Natural gas pricing proposals of President Carter's energy program (Part D of S. 1469). Hearings before the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session on S. 256 a bill to regulate commerce to assure increased supplies of natural gas at reasonable prices for consumers, and for other purposes. Washington, DC; Committee on Energy and Natural Resources (1977). 1098p. GPO.

In 1954, the U.S. Supreme Court ruled that the Natural Gas Act required the Federal Power Commission to regulate the wellhead price of natural gas dedicated to interstate commerce. Ever since that time, natural gas price policy legislation has been an active issue before the Congress. Well over 1,000 separate entries in the Congressional Record related to natural gas during the 94th Congress alone; nearly 200 natural gas bills and resolutions were introduced. In spite of the prolonged debate and discussion during this 23-year-old controversy, no substantial modification of the Natural Gas Act has been enacted. In spite of the fact that wellhead prices for new natural gas in interstate commerce have increased sixfold since 1970, the outlook is bleak. Domestic production peaked in 1973. Production decreases since that time have resulted in producers being unable to meet their supply contracts. Massive curtailments have resulted in losses to the economy totaling millions of dollars. Schools and factories have been closed. Early this year, Congress was forced to pass emergency legislation just to keep people warm in their homes while preparations were made once again to grapple with the price policy problem. It can be agreed that there is a problem, but agreement stops there. Statements were heard from 6 witnesses at the June 7, 1977, hearing, and additional witnesses were heard on June 13, 14, and 17 on natural gas pricing policies. (MCW)

43131 Behind-the-pipe natural gas reserves. Hearings before the Committee on Interstate and Foreign Commerce, House of Representatives, Ninety-Fifth Congress, First Session on allegations of withholding of behind-the-pipe natural gas reserves. Washington, DC; Committee on Interstate and Foreign Commerce (1977). 155p. GPO.

The subcommittee reports on its findings about the allegations that lessees are withholding natural gas reserves "behind the pipe". Testimony was heard on February 22, 1977. Gas "behind the pipe" gas in nonproducing reservoirs which has already been penetrated by one well and some of which, with the drilling of another well, could be flowing to American consumers in a matter of months if the industry opted for accelerated production. Current industry developmental plans do not call for accelerated production allegedly because of considerations of both engineering and economic feasibility. These considerations are examined in a second session, Feb. 23 when Dr. Richard B. Palmer, a spokesman for Texaco, Inc. specifically told why production of their own behind-the-pipe reserves had not been accelerated. Natural gas deposits in the OCS are specifically evaluated. (MCW)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 42183

HYDROGEN AND SYNTHETIC FUELS

43132 (HCP/L2516—01) **Socioeconomic impact assessment: a methodology applied to synthetic fuels.** (Murphy/Williams Urban Planning and Housing Consultants, Philadelphia, Pa. (USA)). Apr 1978. Contract EF-77-X-01-2516. 87p. Dep. NTIS, PC A05/MF A01.

This Report is a supporting document for the Final Environmental Impact Statement, Alternative Fuels Demonstration Program, which was filed with the Council on Environmental Quality in November, 1977. It describes the methodology developed for the socioeconomic impact assessments contained in the Environmental Impact Statement, and highlights the findings. Part I of this Report explains clearly how the numbers are derived, and presents the salient planning issues. Starting with the labor force of a synthetic fuels facility, a public official, decision-maker, or student of socioeconomic impacts can use this Report to derive a reasonable set of estimates which reflect the resultant population, income, employment, land use, public facility costs, and local public revenues. Part II of this Report is the application of this methodology to synthetic fuels. Numerical estimates are given for the social and economic effects resulting from such energy technologies as coal gasification and liquefaction, oil shale, and the conversion of solid wastes and agricultural products to energy. Although the methodology is not site specific, illustrative sites, chosen from the major coal-bearing counties in the United States, have been included. This allows a user to compare the relative impacts of a given energy facility in various geographical locations and types of communities. The section on mitigating measures may be of special interest because of its treatment of problem areas and its broad range of suggested solutions. One advantage of the methodology is that it derives from a broad data base that is readily accessible: the United States Census. Another advantage is that impacts can be calculated by hand. Finally, it is applicable to a wide variety of energy technologies and not restricted to synthetic fuels.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 42651, 43065, 43102, 43105

43133 (HCP/B60830—01) **Powerplant productivity improvement study. Summary report.** (Mechanics Research, Inc., Los Angeles, Calif. (USA)). Feb 1978. Contract EM-76-C-01-8716. 60p. Dep. NTIS, PC A04/MF A01.

In 1974, the Federal Energy Administration initiated a program to improve the productivity of electric power plants as part of its efforts to reduce dependence on imported oil and natural gas; this resulted in many reports and recommendations being made available to industry and government organizations. The work documented in this report is aimed at formalizing the problem-analysis techniques used in the previous studies and provides techniques for assessing and monitoring the cost and benefits of problem resolution. The scope of work is as follows: documents/in-depth techniques for tracing poor productivity to its root causes, develops analytic methods for estimating improvements in unit performance resulting from improved component and subsystem reliability, documents methods for estimating cost effectiveness of specific power plant productivity improvement projects, and defines methods for tracking costs and productivity improvements. The report includes examples of the use of these techniques and methods to verify their usefulness in real power plants (Duke, TVA, and Florida Power and Light). (MCW)

43134 (HCP/B60830—03) **Powerplant productivity improvement study. Appendices 1—4.** (Mechanics Research, Inc., Los Angeles, Calif. (USA)). Feb 1978. Contract EM-76-C-01-8716. 486p. Dep. NTIS, PC A21/MF A01.

These appendices summarize the investigation of the underlying causes of lost power plant productivity at 4 installations—Widows Creek Unit 8, Marshall Unit 4, Turkey Point Unit 4, and Oconee Unit 1. Corrective actions that would help reduce this productivity loss are determined. The methods and techniques developed for determining the causes and corrective actions are documented in the main body of the Phase A report. (MCW)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 43142, 43143

43135 (HCP/B60830—02) **Powerplant productivity improvement study. Volumes I—IV.** (Mechanics Research, Inc., Los Angeles, Calif. (USA)). Feb 1978. Contract EM-76-C-01-8716. 693p. Dep. NTIS, PC A99/MF A01.

The Powerplant Productivity Improvement Study is presented in 4 volumes in this document. Volume I gives information on methods and techniques for determining the underlying causes and corrective actions of lost power plant productivity. Volume II includes a technical summary, step-by-step procedures, and reviews of case histories (Marshall Steam Plant Unit 4 and Turkey Point Unit 4) to discuss productivity improvement. Volume III investigates cost and performance analysis methods. Volume IV is concerned with the cost/benefit analysis of selected power plant improvement programs (Marshall and Turkey Point improvement programs). Much additional data are included in appendices to each volume. (MCW)

43136 **Capital-cost behavior: is nuclear different.** Lotze, C.D. (Nuclear Regulatory Commission, Washington, DC); Riordan, B.J. *Public Util. Fortn.;* **101**: No. 9, 36-41(27 Apr 1978).

The capital costs of coal-fired and nuclear power plants are found to be comparable when costs for pollution control are included. Trends in capital costs reveal a similar rate gain that retains the same economic balance. Graphs of selected cost indices are used to show that the rapid increase in direct construction costs is not unique to nuclear plants, those of hydroelectric plants as well as coal-fired having the same pattern. Comparisons of indirect capital costs, based on analyses of direct capital and total capital costs, show estimated average growth rates of total costs to be 14% for coal and 13.6% for nuclear, while direct cost growth rates are 10.2% and 10.4%. The economics of market competition can be expected to push alternative energy source projects into balance.

43137 **Electric utilities as markets for advanced generating technologies.** Brenner, R.D. (Princeton Univ., NJ). *Public Util. Fortn.;* **101**: No. 8, 25-33(13 Apr 1978).

The author, surveying the history and nature of the electric utility industry (investor-owned), has found that its management is pervaded by conservatism and risk aversion. Historical elements and the fact of its being a regulated monopoly left the industry ill prepared for technological innovation and for anticipating crucial socio-economic developments. All this must change, he implies, as electric utilities must now operate in circumstances that are inhospitable and unforgiving compared to those of the relatively recent past. This article has a twofold purpose: first, to delineate new conditions of America's utilities, explicating their impacts on the structure and workings of the regulated-utility segment of the electric industry, and, second, to explore the probable implications of changing conditions for the marketing of advanced electricity-production technologies, such as fission-based breeder reactors, fusion-fission hybrids, and controlled thermonuclear fusion electric generation plants. (MCW)

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 43107, 43183, 43197, 43204

43138 (AD-A—048128) **Installation electrical consumption and cost data. Final report.** Kukielka, C.; Baum, P.; Botros, M. (Army Facilities Engineering Support Agency, Fort Belvoir, Va. (USA). Research and Technology Div.). 15 Jul 1976. 17p. (USAFESA-RT—2015). NTIS PC A02/MF A01.

This report is a compilation of electric energy consumption and cost data for 43 installations in CONUS. The bases were grouped according to command: FORSCOM TRADOC (including West Point), DARCOM, HSC and ACC. The data was broken down by cost and consumption with each being reduced subcategories. Historical unit cost data for regional located bases for each region is displayed pictorially. Projected 1986 cost have been made for each region using historical data as a guide.

43139 (UCID—17781) **Solar technology applications: a survey of the energy requirements for irrigation pumping.** Newkirk, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Apr 1978. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

To determine the quantity of energy to be supplemented by solar systems, an energy data base for irrigation pumping would be useful. As a first step in developing such a data base, a single reference source is presented which summarizes published information on the energy requirements for irrigation pumping. It is a compilation of literature references and a survey of on-going work in this field. Much of the material is tentative, rapidly changing, and highly variable in time and place. The information should therefore be considered a guide and will be updated as additional information and references appear in the literature.

43140 **Energy consumption measurement: data needs for public policy.** Washington, DC; National Academy of Sciences (1977). 122p. $6.50.

This report identifies the major needs for improved data on energy consumption, specifies the types of data that should be collected, and suggests some general methods of collecting and

organizing these data for use in designing and evaluating public policy. Energy consumption is discussed in terms of the end users in different sectors of the economy: household, industrial, and commercial/service (which includes governments). The analysis is further organized by major end uses within each economic sector: space conditioning (the heating, cooling, and lighting of buildings), transportation (of both people and goods), and materials processing. This classification distinguishes among the different kinds of decisions that are made about energy use in each sector and for each use, the different kinds of information and incentives that influence those decisions, and the different types of data needed to design public policies that may influence those decisions. Data needed to monitor and to model energy use are discussed in Chapters 2, 3, and 4, which describe the household, industrial, and commercial/service sectors respectively. Data needed for assessment of public policies, which apply to all sectors of the economy, are discussed in Chapter 5, concentration on data collection methods, especially the design of controlled and randomized field experiments. In each of the chapters, the methods by which the necessary data might be collected are indicated. An appendix, "State Needs for Data on Energy Consumption", by L.T. Carlson is abstracted separately. (MCW)

43141 State needs for data on energy consumption. Carlson, L.T. pp 101-112 of Energy consumption measurement: data needs for public policy. Washington, DC; National Academy of Sciences (1977).

This appendix attempts to describe some of the specific data needs of states, how these needs are being met, and the data gaps facing many states. It outlines patterns in data needs and programs of the 50 states and describes the specific characteristics of a number of them. The experiences of the state energy offices of New Jersey, Washington, California, Montana, Texas, Minnesota, Oregon, Georgia, and of the New England states provide illustrations of the different kinds of problems encountered by states and the variations in needs and solutions. Problems with existing data on energy consumption at the state level are described, and improvements for the future are indicated. States' energy data needs and programs are in a state of tremendous flux. Programs are now being developed that will change both the needs of states for data and their own energy-consumption data programs. This paper attempts to spell out the minimum data needs that most states share. 10 references.

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

REFER ALSO TO CITATION(S) 42413, 42414, 42445, 42446, 42447, 42460, 42480, 42492, 42531, 43139

43142 Solar homes: the winning combinations. *EPRI J.;* **3**: No. 2, 6-13(Mar 1978).

Several Electric Power Research Institute (EPRI) sponsored experiments are underway to determine whether utilities will need more or less generating capacity to supplement solar heating and cooling systems. Studies of solar-electric rates indicate that electric utilities must charge different rates for solar-heating customers or they will suffer revenue deficiencies. The EPRI program will collect data from ten geographically separated houses having different system configurations and will develop a computer model to predict the effect on utilities. Definitions for load management, heat pumps, energy conservation, and energy storage were agreed upon in the interests of better communication. The EPRI study is well-timed because of the long lead time for new power plants and the possibility of government incentives to encourage solar heating and cooling.

43143 Utilities put the Sun to work. *EPRI J.;* **3**: No. 2, 26-32(Mar 1978).

Samples of solar applications illustrate how utilities are committing funds for research and development of solar energy in anticipation of its becoming a significant contributor to their energy mix. The examples, chosen from 458 programs, include a heating, ventilating, and air conditioning (HVAC) project, biomass, climatic data collection, wind energy, solar collector testing, photovoltaics, and various solar heating and cooling (SHAC) efforts. Funding levels and extent of active participation on the part of utilities are indicated. The information was gathered through a telephone survey by the Electric Power Research Institute, but does not include EPRI-funded projects. SHAC and related research accounts for 74% of the total $15 to $20 million commitment made by 150 investor-owned, public, and cooperative utilities.

43144 EPRI sponsors solar instrumentation. *EPRI J.;* **3**: No. 2, 33-35(Mar 1978).

The Electric Power Research Institute (EPRI) is funding research in a methodology for monitoring solar systems and evaluating the data. In a joint project with DOE, EPRI participated in data analysis and evaluation of eleven solar heating and cooling (SHAC) configurations and found the most cost-effective to be a combination of a solar-assisted heat pump and water storage. Other studies underway include a hospital solar-water-heating system, a solar cooling comparison study, and solar heating and cooling demonsrations. In each case EPRI has funded the portion of the project devoted to developing more accurate and reliable monitoring data. Interim reports will be published in the summer of 1978.

43145 Shape of SHAC supply. *EPRI J.;* **3**: No. 2, 36-38(Mar 1978).

The potential contribution of the solar heating and cooling (SHAC) industry in relieving electric utility loads is the subject of a Donovan, Hamester, and Rattien, Inc. study funded by the Electric Power Research Institute. The rate at which solar technology will enter the market will depend on the conventional factors of how well and reliably it performs, how long it lasts, and what it costs. A market segment that is innovative and independent of cost considerations has caused a rapid growth rate in the number of SHAC equipment manufacturers, although the industry appears to be stabilizing. Marketing techniques have resulted in some fraudulent as well as exaggerated claims by inexperienced dealers. Federal standards are expected for the industry even though there is disagreement over the value of standards already adopted by some states, industrial groups, and federal agencies. The study will collect manufacturing and marketing data and will publish its findings and growth projections in September 1978.

43146 Solar's golden horizon. *EPRI J.;* **3**: No. 2, 39-42(Mar 1978).

The Solar Energy Research Institute (SERI) is located in Golden, Colorado, funded by DOE and operated by the Midwest Research Institute (MRI) to encourage the commercialization of solar technology. SERI's thrust will focus on research and testing to identify viable technologies and programs to support solar industries and create market demand. Two barriers, public myths, and some poor-quality equipment, will be addressed in order to inform the public and establish high standards for the industry. Research efforts will emphasize thermal conversion, photovoltaics, and biomass as the most promising technologies to make a significant contribution.

GEOTHERMAL

REFER ALSO TO CITATION(S) 42458, 42577, 42578

OTHER

REFER ALSO TO CITATION(S) 42458, 42602, 42604

43147 Energy from the ocean. Report of the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, Second Session by the Science Policy Research Division, Congressional Research Service, Library of Congress. Washington, DC; Committee on Science and Technology (1978). 445p. GPO.

In the area of renewable sources of energy from the ocean, the report includes chapters on ocean thermal energy conversion; energy from ocean waves; energy from ocean currents; energy from tides; energy from oceanic winds; energy from salinity gradients; and energy from oceanic bioconversion. Also covered are the nonrenewable sources of energy from the ocean with chapters on deep ocean oil and gas; offshore geothermal energy; and offshore hard mineral energy resources. The report concludes with a bibliography and a selection of current articles on the general subject of the energy potential of the oceans.

ENERGY CONVERSION

REFER ALSO TO CITATION(S) 42414

MHD GENERATORS

REFER ALSO TO CITATION(S) 43120

DESIGN AND DEVELOPMENT

43148 (FE—2246-4) Testing and evaluation of MHD materials and substructures. Annual technical progress report, July 1976—June 1977. Murphree, D.L.; Bell, C.J.; Cain, R.W.; Nail, J.B.; Powe, R.E.; Shepard, W.S.; Wehr, A.G. (Mississippi State Univ., Mississippi State (USA). Energy Research Center). Jul 1977. Contract EX-76-C-01-2246. 148p. Dep. NTIS, PC A07/MF A01.

The objective of this work is to simulate the slag-seed-gas conditions that will exist in various substructures of the coal-fired baseline MHD power plant and evaluate the performance of the substructures. The initial tests will attempt to characterize as closely as possible the ambient conditions that will exist in the radiant boiler of the baseline MHD plant. Information will be obtained on the chemistry of the gas stream and slag deposits at selected points representing radiant boiler locations and the regenerative air heater inlet. A primary objective of this phase of the contract is to provide preliminary engineering data to assist in the design of engineering tests of subscale prototype air heaters and of slag/seed recovery systems. The tests will also provide information for materials selection for the radiant boiler. Following this phase attention may be turned to corrosion studies of superheater components provided sufficient experimental data are available to define the conditions of superheater operation. The scope of work consists of the following tasks: task I. testing and evaluation of metallic components under static conditions; task II. testing and evaluation of metallic components under dynamic conditions; and task III. technical support for the national MHD program.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 43148

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 44017

43149 (CONF-780336—2) **Local measurements in two-phase liquid-metal MHD.** Fabris, G.; Dunn, P.F.; Pierson, E.S. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 2. seminar on MHD flows and turbulence; Beer-Sheva, Israel (28 Mar 1978).

Since the inception of the development of a two-phase liquid-metal magnetohydrodynamic (LMMHD) power generation system at Argonne National Laboratory, increasing emphasis has been placed on the relation between the characteristics of local two-phase flow structure and LMMHD generator efficiency. During the past year a local-measurements program has been undertaken to characterize the local flow structure occurring inside two-phase LMMHD mixers and generators. Continuing local-measurement experiments are in progress at ANL using (single and multiple) resistivity probes and (single) hot-film probes to determine local void fractions, velocities and turbulence intensities. The techniques which have been tested and proved successful in air-water mixtures are now being extended to NaK-nitrogen mixtures, in which some initial tests have been made.

43150 (N—78-11512) **Comparison of several computation methods for inducitive MHD channel and free jet converters with nonmagnetic liquid metals as working fluids.** Djamali-schahni, D. (Technische Univ. Berlin (Germany, F.R.). Sonderforschungsbereich Magnetohydrodynamik). Apr 1976. Contract BMFT-PLE-ET-4003-A. 23p. (SFB-MHD—27). NTIS PC A02/MF A01.

Several methods for calculating inductive MHD converters are summarized and compared. Various converter configurations were investigated: flat and axiymmetric channel and free jet converters, quadrupole and dipole. The flat configurations are compared with the data of an MHD generator. The computer programs described take into account only the electrodynamics of the channel and project converter. The introduction of hydrodynamic aspects is proposed.

THERMOELECTRIC GENERATORS

DESIGN AND DEVELOPMENT

43151 (AD—907810) **Thermoelectric power source PP-6075(XE-2)/U. Final report, 24 March 1970—31 July 1972.** Stroom, P.; Nystrom, T.; Magnuson, K.; Pitcher, E. (Minnesota Mining and Mfg. Co., St. Paul (USA)). Dec 1972. Contract DAAB07-70-C-0015. 81p. NTIS PCA05/MF A01.

The report describes the final design of the PP-6075(XE-2)/U Thermoelectric Power Source, which is comprised of five major functional subsystems: thermoelectric converter, liquid fuel burner, electronic circuitry, fuel system, and cooling system. Three engineering test models were built and evaluated through an extensive weries of performance tests, electromagnetic interference tests, and environmental service tests which are summarized in the report. This activity was followed by the assembly of twelve engineering development models, three of which underwent a reliability test program. The basic objectives of the program were achieved; the PP-6075( )/U Thermoelectric Power Source was designed and qualified in accordance with a broad set of military specifications and standards.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 43151

THERMIONIC CONVERTERS

PERFORMANCE AND TESTING

43152 (N—77-32592) **High efficiency thermionic converter studies. Technical report, 1 July 1976—30 April 1977.** Huffman, F.N.; Sommer, A.H.; Balestra, C.L.; Briere, T.R.; Lieb, D.P. (Utah State Univ., Logan (USA)). Jul 1977. Contract NAS3-20302. 98p. (NASA-CR—135263; TE—4233-152-77). NTIS PC A05/MF A01.

Research in thermionic energy conversion technology is reported. The objectives were to produce converters suitable for use in out of core space reactors, radioisotope generators, and solar satellites. The development of emitter electrodes that operate at low cesium pressure, stable low work function collector electrodes, and more efficient means of space charge neutralization were investigated to improve thermionic converter performance. Potential improvements in collector properties were noted with evaporated thin film barium oxide coatings. Experiments with cesium carbonate suggest this substance may provide optimum combinations of cesium and oxygen for thermionic conversion.

FUEL CELLS

DESIGN AND DEVELOPMENT

43153 **Method and apparatus for electrochemical generation of power from hydrogen.** Anbar, M. US Patent 4,042,755. 16 Aug 1977. Filed date 10 Nov 1975. 6p.

Method and apparatus are disclosed for the pollution-free generation of electrical power from hydrogen. Molten lead is electrochemically oxidized to produce lead oxide and electricity in a single cell in which the resulting lead oxide is simultaneously converted back to lead metal by thermochemical reduction with hydrogen fuel, the entire process being carried out in a single cell using a molten salt as electrolyte in a temperature range of 500 to 900C. The entire cycle consumes only hydrogen and oxygen, while producing electricity.

MATERIALS, COMPONENTS, AND AUXILIARIES

43154 (ANL—78-16) **Advanced fuel cell development. Progress report, October—December 1977.** Ackerman, J.P.; Kinoshita, K.; Finn, P.A.; Sim, J.W.; Nelson, P.A. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

Advanced fuel cell research and development activities in Argonne National Laboratory (ANL) during the period October to December 1977 are described. This work has been aimed at understanding and improving the performance of fuel cells having molten alkali-carbonate mixtures as electrolytes; the fuel cells operate at temperatures near 925°K. The largest part of this effort has been directed toward development of methods for fabricating and evaluating electrolyte structures for these cells. Cell performance, life, and cost are the criteria of optimization. During this quarter, the desirable physical characteristics of $LiAlO_2$ particles, which act to retain the molten carbonates in the electrolyte structure of the cell, have been more clearly defined; a low temperature synthesis of the stable γ-allotrope of $LiAlO_2$ has been devised; an extensive study of $LiAlO_2$ stability has begun; and analytical methods have been refined for separating $LiAlO_2$, in unaltered form, from carbonates. Testing of various electrolyte structures and other components in 7-cm-dia round cells has provided a means for evaluating new electrolyte developments and verifying a previously developed method for protecting the wet-seal areas of a cell from corrosion.

43155 (N—77-32233) **Electrical power requirements analysis, single failure tolerant entry.** Pipher, M.D.; Green, P.A.; Wolfgram, D.F. (National Aeronautics and Space Administration, Houston, Tex. (USA). Lyndon B. Johnson Space Center). 1 Sep 1977. 36p. (NASA-TM—74964; JSC—13046). NTIS PC A03/MF A01.

The results of an analysis of the orbiter electrical power system for the case of a single failure tolerant (SFT) entry are presented. The analysis was performed using the shuttle electrical power system analysis computer program. It was performed to permit assessment of the capability of the orbiter systems to support the proposed entry configuration and to provide the data necessary to identify potential constraints and limitations. Three contingency

modes have been identified which would require an SFT entry. This analysis addresses an SFT entry resulting from the loss of two fuel cell powerplants, while on orbit. The results of the analysis indicate that, even under near optimum conditions, the fuel cell power demand will exceed the tested operating capacity of 16 kw, and that various electrical components may experience voltages below 24 VDC.

APPLICATIONS

43156 (BNL—24224) **Potential fuel cell systems for transportation applications.** Srinivasan, S. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 13p. (CONF-770892—1). Dep. NTIS, PC A02/MF A01.

From Fuel cell powered vehicle workshop; Los Alamos, NM, USA (15 Aug 1977).

The possibilities of hybrid fuel cell/battery powered vehicles is discussed. The various types of fuel cells are discussed, and hydrogen and methane fuel cells are mentioned as the most likely types of fuel cells to be used to power automobiles. (WHK)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

43157 (NTIS/PS—78/0022) **Time series forecasting and prediction (a bibliography with abstracts). Report for 1964-Jan 78.** Grooms, D.W. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 160p. NTIS PC N01/MF N01.

Studies on the use of time series analysis in predicting and forecasting various events are presented. The bibliography includes applications to hydrology, population growth, pollution, motor vehicle accidents, meteorology, criminal investigations, management, and energy consumption. The updated bibliography contains 155 abstracts, 13 of which are new entries to the previous edition.

43158 (PB—275222) **Comparative analysis of selected characteristics of disposable and reusable towels. Research report.** Barber, E.; Fagans, K.; Iannazzi, F.; Shamel, R.; Hallock, K. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Apr 1977. 77p. NTIS PC A05/MF A01.

The environmental impact as measured by six major factors (raw materials, energy and water consumed, solid waste, air and water pollutants generated) and the cost of using disposable paper and reusable cotton napkins were estimated. The comparison was made over the entire life cycle of each type system (e.g., from the origin of raw materials to final disposal of the product) and differences in use patterns of disposable and reusable napkins were considered. Neither disposables nor reusables are clearly superior in all six environmental categories. In general disposables consume more raw materials and generate more solid waste, but consume less energy and generate less water and air pollutants. Disposable napkins were found to be less costly than either commercially or home laundered napkins. Other factors reviewed are product performance and utility and health and sanitation issues.

43159 (PB—275223) **Comparative analysis of selected characteristics of disposable and reusable diapers. Research report.** Barber, E.; Fagans, K.; Iannazzi, F.; Shamel, R.; Hallock, K. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Jan 1977. 90p. NTIS PC A05/MF A01.

The relative merits of disposable and reusable diapers were examined. This study considers product utility and performance, public health and sanitation characteristics, and comparative economics of both kinds of diapers in home and commercial (hospital) applications.

43160 (PB—275224) **Comparative analysis of selected characteristics of disposable and reusable napkins. Research report.** Barber, E.; Fagans, K.; Iannazzi, F.; Shamel, R.; Hallock, K. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Apr 1977. 65p. NTIS PC A04/MF A01.

The relative merits of disposable and reusable napkins were considered. This study considers product utility and performance, comparative economics, and public health and sanitation characteristics of both kinds of napkins in home and commercial applications.

BUILDINGS

REFER ALSO TO CITATION(S) 42486, 43105

43161 (AD-A—047549) **Energy control system applications. Final report.** Baum, P.E. (Army Facilities Engineering Support Agency, Fort Belvoir, Va. (USA). Research and Technology Div.). 24 Jun 1977. 38p. (USAFESA-RT—2035). NTIS PC A03/MF A01.

The recent escalation in the price of energy has been forcing the Army to investigate better ways to achieve effective use of our natural resources. Although considerable attention has been directed towards improved methods of construction of new buildings and of reducing energy consumption in existing buildings, the means of controlling the HVAC equipment in buildings to achieve energy savings has been only lightly addressed. The typical Army installation is spread out over a large area and contains a heterogeneous mixture of buildings with regard to size, age, use, and mechanical systems. Accordingly, their growth and expansion has occurred primarily during a time when neither the technology was available nor did the justification exist for incorporating sophisticated control equipment to achieve more effective energy utilization. That situation has now changed and facilities engineers must examine the energy saving benefits through more effctive energy management with automated controls. Automatic control can simply be defined as a closed loop where control of a piece of equipment is based on feedback, often in the form of an electrical signal, form the equipment being controlled.

43162 (LBL—7810) **History and technical evolution of high frequency fluorescent lighting.** Campbell, J.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract-W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

This work was performed to accelerate development and commercialization of solid-state, high frequency ballasts for fluorescent lighting systems. The history and development of fluorescent lamps, of ballasts for these fixtures, and of related circuits and equipment are reviewed. The higher lamp efficiency of high-frequency (300 to 3000 Hz) fluorescent lamps as compared with 60 Hz lamps, the development of frequency converter circuits for high-frequency lamps, and uses, electrical characteristics, and economics of these lighting systems are discussed. (LCL)

43163 (ORNL/MIT—263) **Supercooling of water in ACES heat exchangers.** Rinaldi, G.M.; Bonnell, L.W.; Geary, C.T. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 20 Dec 1977. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

Supercooled operation of the Annual Cycle Energy System (ACES) ice-maker heat-pump system was examined. From a theoretical analysis of heterogeneous nucleation, four parameters were determined: extent of supercooling, ice-water interfacial tension, contact angle with the substrate, and shape of surface cavities. Coatings of silicone grease and Teflon film on the heat-exchanger surfaces and addition of drag-reducing agents to the water did not result in increasing or prolonging the duration of supercooling significantly.

43164 (PB—274984) **Performance evaluation of window strategies. Final report.** Hastings, S.R. (National Bureau of Standards, Washington, D.C. (USA)). 1977. 10p. Pub. in Proceedings RILEM/ASTM/CIB Symposium on Evaluation of the Performance of External Vertical Surfaces of Buildings, Otaniemi, Finland, 28 Aug-2 Sep 77, v2 p113-122 (Technical Research Centre of Finland, Helsinki) 1977. Available NBS, Washington, DC.

Windows can be an important determinant of the energy consumption of buildings. Properly designed windows can partially or wholly fulfill environmental requirements otherwise necessitating extensive purchased energy consumption by costly mechanical and illumination systems. The energy value of a window is discussed, considering the energy costs attributed to its limitations. To insure its value as a net asset, numerous design strategies are available to improve the conditions in which it performs. Adverse climatic forces can be mitigated through site design or use of exterior appendages. Interior accessories can compensate for the limitations of glass. Finally, building interior design can increase the utility of a window's contribution.

43165 (SAN—1230-2) **Training program for energy conservation in new-building construction. Volume I. Energy conservation technology: management and energy conservation.** (National Conference of States on Building Codes and Standards, Inc. (USA)). Dec 1977. Contract EY-76-C-03-1230. 85p. Dep. NTIS, PC A05/MF A01.

Energy Conservation Technology Series 000.

A Model Code for Energy Conservation in New Building Construction was developed by those national organizations primarily concerned with the development and promulgation of model codes. The technical provisions are based on ASHRAE Standard 90-75 and are intended for use by state and local officials. This training manual is both an introduction to the need for energy conservation in buildings and a definition of the need for and the role of the enforcement official for energy conservation.

43166 (SAN—1230-3) **Training program for energy conservation in new-building construction. Volume II. Energy conservation technol-**

ogy: for the building inspector. (National Conference of States on Building Codes and Standards, Inc. (USA)). Dec 1977. Contract EY-76-C-03-1230. 122p. Dep. NTIS, PC A06/MF A01.

Energy Conservation Technology Series 100.

A Model Code for Energy Conservation in New Building Construction has been developed by those national organizations primarily concerned with the development and promulgation of model codes. The technical provisions are based on ASHRAE Standard 90-75 and are intended for use by state and local officials. This training manual contains the basic information necessary to acquaint the field building inspector with the concepts of energy conservation in buildings and instructs him in the basic techniques of field inspection of energy compliance.

43167 (SAN—1230-5) **Training program for energy conservation in new-building construction. Volume IV. Energy conservation technology: advanced course for plan examiners.** (National Conference of States on Building Codes and Standards, Inc. (USA)). Dec 1977. Contract EY-76-C-03-1230. 420p. Dep. NTIS, PC A18/MF A01.

Energy Conservation Technology Series 300.

A Model Code for Energy Conservation in New Building Construction has been developed by those national organizations primarily concerned with the development and promulgation of model codes. The technical provisions are based on ASHRAE Standard 90-75 and are intended for use by state and local officials. This manual contains a more in-depth training in the review techniques and concepts required by the plan examiners and code officials in administering the code for conventional (buildings of 3 stories or less) construction.

43168 Windows for thermal and sound insulation. Seifert, E. (Institut fuer Fenstertechnik e.V., Rosenheim (Germany, F.R.)). *Elektrowaerme Int., Ed. A;* No. 6, 337-344(Nov 1977). (In German).

New methods of construction and a new approach to the efficient use of energy have imparted new significance to the design of windows. The author explains what steps have to be taken to ensure compliance with rules and regulations relating to the conservation of energy and sound insulation.

43169 Ground as a heat source. Winter, E.R.F. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl C fuer Thermodynamik); Neiss, J. *Elektrowaerme Int., Ed. A;* No. 6, 323-327(Nov 1977). (In German).

The thermophysical properties of various types of soils depend on dry bulk density, water content and mineral components. The time dependent temperature distribution of the undisturbed ground is presented. The energy required from the ground to heat a dwelling is determined from the demand, the ratio of heat exchange area in the ground to heated area of house, the coefficient of performance of the heat pump installation, and the time dependent outdoor temperatures. From these quantities the brine temperatures in the heat exchanger pipes are calculated for various types of soils, depths and centerline distances at which the pipes are installed. These brine temperatures must be adjusted in order that the required amount of heat be transferred from the ground to the brine during the heating period.

43170 Uses of phenolic foams for the thermal insulation of buildings. Schuetze, H. (Roland-Werke F. Waldmann K.G., Achim (Germany, F.R.)). *Elektrowaerme Int., Ed. A;* No. 6, 345-347(Nov 1977). (In German).

From 23. plastics colloquium on energy safing by means of better thermal insulation with foamed plastics; Wuerzburg, Germany, F.R. (15 Dec 1976).

The exacting demands imposed on the thermal insulation of buildings have led to the development and introduction of new building materials. Rigid phenolic foam slabs play a significant role because they are available in different types and are suitable for a variety of applications. Low thermal conductivity and a high fire resistance are their outstanding properties. The possibility of coating the slabs with different materials widens their uses. Properties and applications of this insulating material are described in detail.

43171 Publication of the standards referred to in the regulations concerning energy conservation. Of April 19th, 1977. *Bundesanzeiger Beil.;* No. 10, 1-55(May 1977). (In German).

1) Supplement DIN 4108 - thermal insulation in building construction (October 1974 version); 2) DIN 18055, page 2 - windows; air permeability of joints and driving rain protection (August 1973 version); 3) DIN 4242 - walls made of glass blocks (January 1973 version); 4) DIN 18175 - glass blocks (December 1960 version); 5) DIN 4701 - heating systems; guidelines for the calculation of the heat consumption of buildings (January 1959 version).

43172 Window design strategies to conserve energy. Hastings, S.R.; Crenshaw, R.W. Washington, DC; Government Printing Office (1977). 222p. $3.75.

A multitude of design strategies are available to achieve energy-efficient windows. Opportunities for improving window performance fall into six groups: site, exterior appendages, frame, glazing, interior accessories, and building interior. Design strategies within these groups can improve one or more of the six energy functions of windows i.e., solar heating, daylighting, shading, insulation, air tightness, and ventilation. Included are 33 strategies; an explanation of the physical phenomena responsible for each strategy's energy performance, summarized energy and non-energy advantages and disadvantages; aesthetic considerations; cost approximations; example installations, laboratory studies, or calculations by the authors; and references. Intended readers include professional designers, lessees and owners of commerical space, home buyers and owners, window component manufacturers, and researchers. This report draws attention to the wide range of options currently available to conserve energy with windows.

RESIDENTIAL BUILDINGS

43173 (NMEI—76-164) **Implementation—ASHRAE standard 90-75. Final report.** van der Meer, W.J. (New Mexico Univ., Albuquerque (USA)). Nov 1977. 9p. State of New Mexico Energy and Minerals, Santa Fe.

Based on a study of meteorological conditions in New Mexico, the state was divided into 11 climatic zones, and building wall design conditions were determined for each zone. Using the concept of an Effective U Value, defined as the average heat transfer rate through a wall over an extended time, e.g., an entire season, 26 different wall types with various window combinations and color tones were designated as acceptable by ASHRAE Standard 90-75 building code. Also, 26 houses in the Albuquerque area were surveyed for actual energy consumption and computed energy use using both traditional and the Effective U Value computing methods. Calculations by the Effective U Value method were much closer to measured energy consumption. New Mexico has adopted an Energy Conservation Building Code and use of Effective U Values to determine whether wall constructions are in compliance with the code have promoted the code's implementation. (LCL)

43174 (PB—275471) **Energy usage characteristics of single-family residences and their occupants in Illinois. Volume 3. Statistical analyses. Final report.** (Nielsen (A.C.) Co., Northbrook, Ill. (USA)). Aug 1977. 71p. NTIS PC A04/MF A01.

Volume 3 of this study performs a statistical analysis of the characteristics measured and determines their effects upon potential energy savings in single-family dwelling units. The analysis explores the relationship of social, economic, attitudinal, and solar refit characteristics associated with potential energy savings. (Portions of this document are not fully legible)

43175 Operating results of a soil-to-water heat pump. Ginschel, J. *Elektrowaerme Int., Ed. A;* No. 6, 332-337(Nov 1977). (In German).

The heat pump plays a significant role in the present endeavors to reduce the consumption of primary energy for space-heating purposes by conserving of energy or resorting to virgin sources of energy. Its use requires a sound thermal design of the building and enables solar energy stored in air, water or ground to be withdrawn. In the system described, only about 30% of the work required annually must be supplied in the form of electrical energy with a mean coefficient of performance of 3.3; 70% is withdrawn from the ground as a source of stored solar energy. Considering the conversion loss in the generation and use of electricity and the efficiency in the supply and use of fossil fuels in conventional heating systems, the consumption of primary energy of the heat pump installation described is only about 50%. As the heat extraction area must be at least twice as large as the heated floor area, depending on the type of soil, the use of soil-to-water heat pumps will be restricted to detached single and two-family houses.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 43204, 43205

43176 (PB—273403) **Feasibility of an energy-related loan program for low-income homeowners.** Eccli, E. (Design Alternatives, Inc., Washington, D.C. (USA)). Oct 1977. Contract CSA-B7B-5537. 94p. NTIS PC A05/MF A01.

The study explores the opportunities to create an interest subsidized residential retrofit loan program which would assist low-income homeowners to substantially reduce their utility bills. Energy conservation techniques which would be cost effective in a loan package were identified. The methodology used included a literature search to locate wherever possible actual measurements of energy and cost savings for areas of energy use and supply including furnace retrofits, water heating, appliances, lights, the effects of natural and mechanical ventilation, and the use of renewable energy sources

such as solar space and water heating. An engineering/economic analysis of the options available through a 20 year loan program and at interest rates of 1, 3, and 6% was performed. It was found that substantial reductions in utility bills can be obtained with such a loan program. The information in the study would be useful to other income groups besides the poor. References and a list of information sources are included.

43177 Heat pumps for the administrative buildings of an industrial plant. Junker, H.D. *Elektrowaerme Int., Ed. A;* No. 6, 348-349(Nov 1977). (In German).

The paper reviews two years' operational experience with the plant.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

43178 (HRP—0015880) **Life cycle budgeting and costing as an aid in decision making. Volume II. Energy handbook.** (Naramore, Bain, Brady, and Johnson, Seattle, Wash. (USA)). Jun 1976. Contract DHEW-110-75-0172. 186p. NTIS PC A09/MF A01.

Techniques and procedures for assessing alternatives in terms of energy use, conservation, and related monetary costs or fiscal resources are presented in a handbook directed to those who make planning decisions concerning the construction or renovation of health care facilities. The handbook is one of a series documenting the life cycle costing procedure for evaluating the initial and long-term cost implications of a decision before the decision is made. Applicable throughout the planning, budgeting, programming, design, construction, and operation phases of the procurement process, life cycle costing provides a structured method for comparing over a given period of time the cost impacts of potential alternatives or for evaluating the relative costs of two or more developed alternatives. The energy handbook opens with an overview of the application of life cycle costing to energy-related decisions. The basic concepts involved in evaluating energy / cost / operational tradeoffs are explained. Specific decisionmaking steps are described relative to the energy source level (utility, solar, onsite generated, or geothermal energy); facility programming and building concept level; system and system component level (e.g., heating, ventilating, and air conditioning subsystems, pumping systems, electrical subsystems, plumbing subsystems); operations level; and annual energy density criteria (all levels). Reference charts and tables and lists of additional references are provided. Application of the costing techniques and procedures to a medium-sized general hospital is described.

43179 (HRP—0019524) **Practical energy management in health care institutions.** (Blue Cross of Greater Philadelphia, Pa. (USA)). 1977. 67p. Available from Blue Cross of Greater Philadelphia, 1333 Chestnut St., Philadelphia, PA 19107.

Energy management in hospitals and other health care institutions is proposed, based on a program to assist six hospitals in Philadelphia, Pa. Energy management is defined as the explicit consideration of energy and its cost in managing and planning hospitals. Engineering and maintenance personnel are the focal point of energy information. Most energy in hospitals is concentrated in a few functions or systems, including environmental control, lighting, wall receptacles, laundry, food service, medical equipment, sterilization, and incineration. It is estimated that energy costs represent e to 5% of hospital budgets. Energy indicators and cost indicators to consider in the implementation of an energy management plan are total energy cost per year, percent of operating budget for energy, total energy cost/ft^2/y, total energy/ft^2/y, and cost per unit of energy (average for the year). Steps in energy management are detailed and strategy is presented that is specifically aimed at directors and managers responsible for daily tasks of energy conservation. Case histories are cited and data collection and analysis procedures and guidelines for building and equipment surveys are detailed. Energy-saving ideas particularly relevant to health care institutions are noted. A checklist for use in the conduct of facility surveys, energy data forms, and financial evaluation procedures are appended.

43180 (SRC-TR—77-595-6) **Adoption of energy conservation technology by the Syracuse and Rochester City school districts.** Shea, P.E. (Syracuse Research Corp., N.Y. (USA)). Dec 1977. Contract EY-76-C-02-4044. 110p. (COO—4044-2F). Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

Data are presented on energy consumption for the heating and lighting of public schools in Rochester and Syracuse, N.Y. and the methods considered for conserving energy in these schools. These methods included school closings, financial incentives to individual schools for decreasing energy usage, improved boiler maintenance, retrofitting windows, retrofitting boilers, and use of heat recovery equipment. The role of school personnel, board of education, city council, and utility companies in implementating energy conservation options and the legal aspects of such implementation are discussed. (LCL)

TRANSPORTATION

AIR AND AEROSPACE

43181 (N—78-10035) **Cost/benefit tradeoffs for reducing the energy consumption of the commercial air transportation system. Summary report, 5 Nov 1974—30 Jun 1976.** Kraus, E.F.; Vanabkoude, J.C. (Douglas Aircraft Co., Inc., Long Beach, Calif. (USA)). Jun 1976. Contract NAS2-8618. 77p. (NASA-CR—137925). NTIS PC A05/MF A01.

The fuel saving potential and cost effectiveness of numerous operational and technical options proposed for reducing the fuel consumption of the U.S. commercial airline fleet was examined and compared. The impact of the most promising fuel conserving options on fuel consumption, passenger demand, operating costs and airline profits when implemented in the U.S. domestic and international airline fleets was determined. A forecast estimate was made of the potential fuel savings achievable in the U.S. scheduled air transportation system. Specifically, the means for reducing the jet fuel consumption of the U.S. scheduled airlines in domestic and international passenger operations were investigated. A design analysis was made of two turboprop aircraft as possible fuel conserving derivatives of the DC-9-30.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 43191, 43192, 43211

43182 (COO—4338-1) **Air leakage in refrigerated vans. Progress Report No. 1.** (Bodenheimer (B.A.) and Co., Inc., Stamford, Conn. (USA)). Nov 1977. Contract EC-77-C-02-4338. 121p. Dep. NTIS, PC A06/MF A01.

As a result of the increasing costs of energy, the United States Department of Energy has undertaken, through this study, to investigate the state of the art of the measurement of air leakage in refrigerated vans. The theoretical basis for current test standards for air leakage are reviewed, and the requirements of such standards compared to the inservice use conditions. The current tests standards are directed to providing a measurement of the heat loss effect of air leakage to allow compensation for this effect, rather than identifying sources of air leakage in trailers and containers to reduce the energy waste. It is shown that available data on the effect of internal and external temperature variation on air leakage is insufficient to establish general conclusions, and that additional testing should be directed to obtaining this data. To provide more accurate air leakage measurements, and thus to provide a basis for more energy-efficient construction, testing at more than one internal temperature is needed and this can be accomplished in the field by portable instrumentation. The accuracy of measurements required by current standards is compared to that needed in multiple temperature measurement, and equipment costs and test costs are compared.

43183 (PB—273288) **Study design for a method of projecting vehicle miles of travel. Final report, July—September 1975.** Rabe, F.T. (Environmental Impact Center, Inc., Newton, Mass. (USA)). Aug 1977. Contract DOT-TSC-10596. 54p. NTIS PC A04/MF A01.

Vehicle miles of travel (VMT) by passenger automobiles is an important determinant of gasoline consumption, ambient air quality, highway safety, and personal and corporate financial conditions in the United States. Changing patterns and trends in VMT, therefore, have profound implications for energy conservation, environmental quality, and economic stability. Forecasts of likely future levels of VMT have become a central input to transportation policy analysis. The report is an effort to assess the state of the art of VMT forecasting and map out strategies for extending it. The work included an inventory of data sources and a review of existing VMT models.

43184 (PB—274864) **Variations in tire rolling resistance.** Thompson, G.D.; Torres, M. (Environmental Protection Agency, Ann Arbor, Mich. (USA)). Oct 1977. 35p. (LDTP—77-5). NTIS PC A03/MF A01.

The paper analyzes the tire rolling resistance data obtained in a recent EPA road load project. Variations in the observed tire rolling resistances were analyzed versus tire type, tire manufacturer, and tire size. The fuel economy effect of a change in tire types; that is, from bias to radial tires, has been previously reported and is briefly discussed. From these results it is concluded that a 10% change in rolling resistance will yield approximately a 1% change in the vehicle fuel economy. At the present time, reduction of fuel consumption through optimization of tires cannot be expected to occur since there is no uniform method of rating and reporting tire energy dissipation. The development of a consistent, uniform

method of rating and reporting tire energy dissipation over cyclic driving schedules, such as the EPA test schedule, is recommended.

43185 (PB—274865) **Shift schedules for emissions and fuel economy testing.** Rykowski, R.A. (Environmental Protection Agency, Ann Arbor, Mich. (USA)). Nov 1977. 32p. (LDTP—77-6). NTIS PC A03/MF A01.

The purpose of this report is to examine the current method of determining the shift schedules used during certification and determine if this method is resulting in shift schedules which are representative of those used by typical drivers. The history of the method of determining shift schedules for the certification process is first examined. Then the current trends of shift schedules found in vehicle owner's manuals are determined, since these are the sources of the shift schedules used during certification. Next, the methods of determining shift schedules of other automobile testing organizations are examined, as well as how people are taught to shift in driver's education schools. Finally, data are presented comparing on-the-road shift speeds to those recommended by the manufacturers. Conclusions and recommendations on alternative methods of determining certification shift schedules are presented.

SEA AND WATER

43186 (AD-A—046919) **Large hydrofoil transmission system study. Final report.** (AiResearch Mfg. Co., Torrance, Calif. (USA)). 11 Oct 1977. Contract N00014-76-C-0803. 31p. NTIS PC A03/MF A01.

This report presents the results of a study to determine the performance and physical characteristics of an ac electrical system intended for use as the propulsion system of large hydrofoils. Section I provides a technical description of the system in terms of performance, weight and component characteristics. Section II describes anticipated problems associated with development of the system and its components, and includes activities through design and fabrication, and qualification of an integrated system. Two system configurations are considereed in this study. Configuration I which is the preferred one, consists of two direct-turbine-driven ac generators supplying electrical power to either foilborne or hullborne propeller induction drive motors. Conventional switchgear is used for connecting the generator to either the foil or hull drive motors. Each induction motor supplies power to a fixed pitch propeller via a planetary type gearbox. Speed and power output of each induction motor is controlled by fuel to the turbine. Configuration II consists of independent foilborne and hullborne propulsion systems. For takeoff and foilborne operation, two direct LM2500 turbine-drive ac generators supply electrical power to the foil propeller induction motors. Operation in this mode is identical to Configuration I. Configuration II provides a trade off between greater system weight, against a lower hullborne fuel consumption rate obtained by operating smaller turbines in hullborne mode. This provides, potentially, a greater hullborne range.

PIPELINE

REFER ALSO TO CITATION(S) 43421

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 43079, 43139

43187 (FEA/D—77/239) **Developing a maximum energy efficiency improvement target for SIC 28: chemicals and allied products. Volume 2. Draft target and support document appendices. Part 1.** (Battelle Columbus Labs., Ohio (USA)). 1 Jul 1976. Contract EM-76-C-01-8625. 284p. Dep. NTIS, PC A13/MF A01.

Part 1 of this appendix contains the detailed supporting documentation and rationale for the energy efficiency improvement goals for each of the component industries in Standard Industrial Classification (SIC) 28. SIC 28 includes: industrial inorganic and organic chemicals, synthetic materials except glass; drugs; paints, varnishes, etc.; agricultural chemicals; and miscellaneous chemical products.

43188 (FEA/D—77/240) **Developing a maximum energy efficiency improvement target for SIC 28: chemicals and allied products. Volume 3. Draft target and support document. Appendices. Part 2.** (Battelle Columbus Labs., Ohio (USA)). 1 Jul 1976. Contract EM-76-C-01-8625. 245p. Dep. NTIS, PC A11/MF A01.

Part 2 of this appendix contains the detailed supporting documentation and rationale for the energy efficiency improvement goals for each of the component industries in Standard Industrial Classification (SIC) 284 which includes soap, detergents and cleaning preparations, and cosmetics, perfumes and other toilet preparations.

43189 (FEA/D—77/241) **Developing a maximum energy efficiency improvement target for SIC 28: chemical and allied products. Volume 4. Draft target and support document. Revisions and addenda.** (Battelle Columbus Labs., Ohio (USA)). 1 Jul 1976. Contract EM-76-C-01-8625. 176p. Dep. NTIS, PC A09/MF A01.

In accordance with section 374 of the Energy Policy and Conservation Act (EPCA), Pub. L. 94-163, the Federal Energy Administration (FEA) proposed industrial energy efficiency improvement targets for the ten most energy-consumptive manufacturing industries in the United States. This proposed target is based on the best available information and is established at the level which represents the maximum feasible improvement in energy efficiency that the Chemicals and Allied Products Industry (Standard Industrial Classification 28) can achieve by January 1, 1980, taking into account considerations of the technological feasibility and economic practicability of utilizing alternative operating procedures and more energy efficient technologies. The draft target represents the percentage reduction in energy consumed per unit of output or activity that can be achieved between calendar year 1972 and January 1, 1980. The draft target was subject to oral and written presentation of views.

43190 (PB—275225) **Resource and environmental profile analysis of selected disposable versus reusable diapers, napkins and towels. Research report.** Barber, E.H.; Fagan, K.P. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Mar 1977. 160p. NTIS PC A08/MF A01.

The objective of this REPA analysis is to compare resource depletion and environmental degradation impacts created by the manufacture and use of selected disposable and reusable products. The resource and environmental factors considered were grouped into seven basic REPA impact categories. Energy, materials, and water are inputs to each product system studied. Process and post-consumer solid wastes, atmospheric emissions and waterborne wastes are outputs from each product system studied. The REPA analysis measures these impacts through a complete product life cycle. For a disposable paper product, the REPA study begins in the area of woodlands harvesting. The study then progresses through pulp and paper making, product converting, and use/discard/final disposal. For a reusable cotton cloth product, the study begins in the area of cotton growing and ginning and progresses through spinning, weaving, finishing, converting, laundering, and use/discard/final disposal. For a synthetic fiber cloth product, the study begins in the area of oil and natural gas production for polyester and woodlands harvesting for rayon. It then progresses through chemical intermediates production, polymerization, spinning, weaving, finishing, converting and use/discard/final disposal. The analysis also includes impacts associated with the transportation of these materials and products from site to site, and recycling that takes place within the production processes.

MATERIALS

43191 (PB—272989) **Utilization of waste boiler ash in highway construction in Arizona. Part I. Portland cement concrete. Final report, September 1974—December 1976.** Rosner, J.C.; Hamm, M.K. (Engineers Testing Labs., Inc., Phoenix, Ariz. (USA)). Dec 1976. 212p. NTIS PC A10/MF A01.

Waste fly ash is produced by several coal-fired power generating plants in and adjacent to Arizona. A literature search, laboratory test program and analysis of test data indicate that available fly ashes can be advantageously used as admixtures in portland cement concrete for highway construction. Compressive strength, flexural strength, resistance to sulfate attack and freeze-thaw durability are included in the laboratory test series. Test data are used in the development of a mix design procedure aimed at optimizing the proportions of fly ash and portland cement.

43192 (PB—272990) **Utilization of waste boiler ash in highway construction in Arizona. Part II. Soil stabilization. Final report, September 1974—January 1977.** Rosner, J.C.; Hamm, M.K. (Engineers Testing Labs., Inc., Phoenix, Ariz. (USA)). Jan 1977. 181p. NTIS PC A09/MF A01.

Waste fly ash is produced by several coal-fired power generating plants in and adjacent to Arizona. A literature search, laboratory test program and analysis of test data indicate that available fly ashes can be advantageously used in lime-fly ash soil mixtures for highway construction. Unconfined, compressive strength, and freeze-thaw and wet-dry durability are included in the development of a mix design procedure aimed at optimizing the proportions of fly ash and lime.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 43104, 43105

43193 (CONF-771125—3) **Use of microwave energy in conjunction with fluidized bed reactors.** Lynch, E.P. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From 3. international conference of environmental problems of the extractive industries-materials, energy and environment; Dayton, OH, USA (29 Nov 1977).

A proposal is made for developing a pilot plant for demonstrating the use of microwave heating in conjunction with the operation of fluidized bed reactors. Fluidized bed reactors are widely used in the chemical, petrochemical, and petroleum industries. Microwave heating of particles in a fluidized bed has the advantages that heat is generated within individual particles, no combustion gases or outside contaminants are in contact with the particles, and no differential temperature is required for heat transfer to a particle in the radiation field. It is believed that the use of microwave energy for particle heating would result in fluidized bed operations with the same or improved efficiency at appreciably lower temperatures. (LCL)

43194 (PB—275776) **Computer modeling to maximize water-use efficiency and reduce energy in irrigation.** (Nebraska Univ., Lincoln (USA). Dept. of Agricultural Engineering; Nebraska Univ., Lincoln (USA). Water Resources Research Inst.). 1 Oct 1977. Contract DI-14-34-0001-7058. 33p. NTIS PC A03/MF A01.

A simplified irrigation scheduling model, IRRIGATE, has been developed as an educational tool for use by University personnel and in extension programs. Irrigations are scheduled using the basic premise of maximizing yields with a minimum of applied irrigation water. Use of IRRIGATE has grown rapidly in Nebraska. A mathematical model, CORNGRO, has been developed to predict daily crop water use, plant growth and crop yield for corn. CORNGRO has the capability of predicting corn yield as a result of different irrigation timing and amounts. The model can be useful in evaluating irrigation scheduling procedures in terms of yield, water conservation, energy conservation, production costs, and analyzing alternate levels of water applied.

43195 (TID—28215) **Energy savings through the use of an improved aluminum reduction cell cathode. Final report, May 1, 1976—November 30, 1977.** (Kaiser Aluminum and Chemical Corp., Oakland, Calif. (USA)). 30 Nov 1977. Contract EY-76-C-03-1257. 64p. Dep. NTIS, PC A04/MF A01.

A 15,000A aluminum reduction cell was built and operated for 66 days to screen the structural stability and overall performance of four varieties of titanium diboride serving as wettable cathode surfaces. While the cell has to be shut down well before it could attain its goal of 180 days of operation, it confirmed the promise of TiB_2 cathodes as a means of lowering the anode-cathode distance in aluminum cells (i.e., the voltage drop through the electrolyte) thus considerably reducing the energy requirement of the aluminum reduction process. Specifically, the work yielded a useful screening test for candidate TiB_2 materials and clearly identified one of the materials as satisfactory for its intended purpose. The autopsy revealed that all of the TiB_2 tiles under the anode shadow were displaced toward the metal well and the cell periphery; most were found broken. The observed breakage of the majority of TiB_2 shapes has been attributed to the mechanical forces arising from the daily cell servicing operations. Loose tiles displaced into the center trench were broken by the demucking operations necessitated by the erratic alumina feed system peculiar to this small cell. The premature shutdown of the cell was due to the detachment and subsequent displacement of the tiles. The autopsy also showed the tiles supplied by PPG Industries to have superior properties and the best potential for service in the corrosive environment of a reduction cell. The results plus the excellent chemical stability of one TiB_2 candidate substantiate the ultimate practicality of retrofitting the U.S. aluminum smelters with cathodes that will achieve the projected 25% reduction of energy usage--thus mandating the continuation of the development program.

43196 **Operating characteristics of a mixed refrigerant vapour compression system.** Saluja, S.N.; James, R.W.; Cryne, A. *Refrig. Air Cond.;* **81**: No. 960, 80, 84-86(Mar 1978).

The use of non-azeotropic mixtures to produce non-isothermal refrigeration for process refrigeration duties are examined. It is apparent that there are advantages obtainable by using mixtures; these advantages, in terms of power savings or increased refrigeration capacity tend to be somewhat over-estimated by theoretical analysis compared to results obtained from experimental units. The power savings and improved refrigeration capacity will only be obtainable if certain conditions are observed. These are: (1) the condenser and evaporator must be designed to obtain countercurrent flow between the mediums; (2) the condensation process must be one of equilibrium condensation; (3) the heat transfer surfaces must be designed to accommodate equilibrium condensation and evaporation (shell and tube condensers and evaporators cannot provide these conditions); and (4) the heat transfer surface areas must be suitably modified to allow for the reduced heat transfer coefficients and decreased temperature differences.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 42106, 42168, 42888

43197 **Heat recovery as it is practised by the firms which profit from it.** Beatson, C. *Engineer (London);* **246**: No. 6371, 54-55(4 May 1978).

To promote heat recovery as a worthwhile proposition for industry the British Electricity Council is organizing a mobile exhibition showing what individual firms are doing and the rewards they are earning. These examples should encourage other firms to explore heat recovery as a cost effective exercise. The exhibition will show that heat pipes are not exotic pieces of hardware having limited practical applications; that heat exchangers may have far wider potential usage than the milk and petrochemical industries, and that we are only on the threshold of the development of industrial heat pump technology. Recovery of waste heat is specially attractive because often it can be implemented by adapting an existing plant with the prospect of immediate energy savings and is applicable to a wide range of different industries.

43198 **Thermo-extraction: a project for using residual hot water to separate mixtures.** le Goff, P.; Tondeur, D. (CNRS, Nancy, France). *Entropie;* **14**: No. 79, 5-17(1978). (In French).

It is proposed to search systematically for uses of the thermal energy contained in residual water at approximately 50°C, by means of thermochemical or thermobiological converters, based on the use of labile chemical systems, i.e., molecular equilibriums whose composition varies greatly with the temperature. Thermoextraction consists of separating a mixture by means of an extractant of which the partition coefficient for a solute of the mixture depends on the temperature. A list is given of all the thermoextractor structures which can a priori be envisaged, operating between a hot source at approximately 50° C and a cold source at approximately 10°C. It is shown that pure spatial structures, comprising a single loop with two heat exchangers and two contactors, are of little value, even when each of the contactors is equivalent to an infinite number of theoretical stages of equilibrium. But by adding a recycling circuit of either the extract or the raffinate, it is possible to achieve a separation of quality as great as is required.

INDUSTRIAL WASTE MANAGEMENT

43199 (PB—273286) **Automobile scrappage and recycling industry study: overview report. Final report, June—December 1975.** Kaiser, R.; Wasson, R.P.; Daniels, A.C.W. (H.H. Aerospace Design Co., Inc., Bedford, Mass. (USA)). Sep 1977. Contract DOT-TSC-1028. 409p. NTIS PC A18/MF A01.

The principal factors which influence the recovery of materials from junked automobiles are reviewed and evaluated. These include the number and materials composition of the automobiles that are retired annually in the U.S.; the flow of junk automobiles into the commercial recovery cycle and problems associated with abandoned automobiles; operations of the auto wrecking industry where serviceable parts are salvaged; and the structure, operations and technology of the scrap industry which transforms automobile hulks into commercial grades of metal scrap. Since Federal laws and policies impact on the reclamation of materials from junked automobiles, a legal review of key legislation and policies is also included. Because of a strong demand for auto hulks by scrap processors, created by an increased market for ferrous scrap, the problem of an ever increasing accumulation of unprocessed deregistered automobiles has been stabilized. In 1974, the fractional recovery of metallic materials from the approximately ten million automobiles deregistered that year was higher than from other forms of obsolete scrap. The estimated value of the recovered materials was in excess of one billion dollars.

43200 **Protecting the environment in the Netherlands.** *Water Waste Treat.;* **21**: No. 3, 23-24(Mar 1978).

The geographic and demographic features of the Netherlands, its high degree of industrialization, its intensive horticulture and agriculture, and its prevailing wind patterns combine to create a greater need for pollution control than is necessary in other countries. The environmental protection laws which have been passed and their effects on waste disposal, waste processing, investment in pollution control equipment and the monitoring of air and water pollution are discussed. (LCL)

43201 **Economics of recovery of materials from industrial waste: a case study.** Bridgwater, A.V. (Univ. of Aston, Birmingham, Eng.). *Resour. Recovery Conserv.;* **1**: No. 2, 115-127(Oct 1975).

Millions of pounds worth of valuable materials are discarded every year in industrial wastes. While there are well established recycling patterns for some materials, most are lost because contamination, dilution, or scale of operation makes recovery uneconomical. The problems and possibilities of recovering valuable materials from liquid and liquid-solid industrial wastes are outlined by reference to

evaluations made in several case studies. In particular, an examination is made of wastes removed by a West Midlands disposal contractor over a twelve month period. The ways in which these wastes are dealt with at present by surface and subsurface disposal are discussed along with the hazards and safety factors inherent in such operations. The examination shows that in the wastes disposed of the most potentially valuable materials to recover were hydrochloric acid and zinc. The relationship between recovery and dumping is discussed and future trends suggested. This shows that recovery of more materials should be undertaken, perhaps as a governmental service, and that the advantages of economy of scale must be utilised, by combining wastes from several sources.

43202 Resource potential of demolition debris in the United States. Wilson, D.G. (Massachusetts Inst. of Tech., Cambridge). *Resour. Recovery Conserv.;* **1**: No. 2, 129-140(Oct 1975).

The scanty data which are available on the generation of demolition debris in the United States are reviewed. Estimates are made of the proportions of the constituent materials in debris which are recycled in any form. The institutional, economic and technological restrictions preventing a greater proportion of materials from being recycled are described, and suggestions are made of methods by which a higher level of recycling can be brought about.

MUNICIPALITIES AND COMMUNITY SYSTEMS

43203 (PB—275054) **Physical, chemical, and biological treatment techniques for industrial wastes. Volume I. Final report.** Berkowitz, J.B. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). 1977. Contract EPA-68-01-3554. 483p. (ADL-C—78950-F). NTIS PC A21/MF A01.

There is a strong need for treatment processes which can detoxify, destroy, or apply resource recovery principles to industrial wastes. This study examined 47 unit engineering processes for their applicability to the task of treating hazardous industrial wastes. Some of these unit processes are commonly used for industrial waste treatment while others require further RandD efforts before they will become commercially attractive. Four (dialysis, electrophoresis, freeze drying and zone refining) were found not to be applicable to waste treatment. Part Two of this report presents comprehensive descriptions of each of the unit processes, including information on the basic principles, areas of application, economics, energy and environmental considerations, and an outlook for future use on industrial wastes. Thus, Part Two is in essence an up-to-date reference textbook on potential treatment processes.

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 43107

43204 (PB—275485) **Impact evaluation of New York State Energy Code (ASHRAE 90-75) on office building construction in New York City.** Flack, P.; Rainer, G.; Steiner, S.; De Pinto, D.; Schieder, K. (New York State Energy Research and Development Authority, New York (USA); Flack and Kurtz, New York (USA); Citizens' Advisory Committee on Environmental Quality, Washington, D.C. (USA); Kaufman (William) Organization, New York (USA)). Dec 1977. 94p. (NYSERDA—75/35). NTIS PC A05/MF A01.

This report documents the implications of the Code as it may affect the first costs, operating costs, energy consumption, and marketability. It also investigated the impact of the Code on the New York City utility systems, the manufacturers of mechanical and electrical equipment, and the construction trades.

PUBLIC SERVICES

43205 (SRC-TR—77-595-5) **Renovating the halls of local government with innovative heat pump technology: Rochester and Monroe County.** Roberts, D.D. (Syracuse Research Corp., N.Y. (USA)). Dec 1977. Contract EY-76-C-02-4044. 26p. Dep. NTIS, PC A03/MF A01.

In Rochester, a once-abandoned old Federal building is being renovated and given a 42,000-ft^2 annex to become the "new" city hall. The decision to renew the building with construction contracts totaling over $1 million on an HVAC system incorporating heat pumps, heat wheels, and heat-recovery tanks is followed. The HVAC system will also have the potential for solar heating. Likewise, Monroe County renovated a county office building, installing a new HVAC system incorporating heat pumps and heat-recovery wheels at a cost of $760,000. The process to decide to renovate the county office building is also followed. Both buildings were old, massive structures. (MCW)

PUBLIC UTILITIES

43206 (SRC-TR—77-595-3) **Street lighting in Rochester: the search for innovation in technology and joint decision-making.** Roberts, D.D. (Syracuse Research Corp., N.Y. (USA)). Dec 1977. Contract EY-76-C-02-4044. 40p. Dep. NTIS, PC A03/MF A01.

Street lighting is the largest single energy expenditure in Rochester. It is one area for energy conservation in which readily available technology exists that could offer immediate, drastic energy savings. Systematic installation of energy efficient lamps such as high-pressure sodium may result in a 60% decrease in energy required by earlier generation technologies. With the problem and an apparent solution feasible, it is wondered why cities have not completely installed the energy and money conserving systems. Most citizens consider a street lighting system a public service. Mostly they are serviced by a local investor-owned utility. So the service becomes a complex operation, requiring interdependent decision making. These procedures are followed from the early days of street lighting in Rochester to the present structure. It demonstrates that in this period of strain placed upon ingrained interinstitutional relationships, citizen disenchantment, rising costs, competing priorities for both utility and municipal capital; it is exceedingly complex and difficult for the municipality to replace the old with new innovative organizational structures. (MCW)

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42407, 42408, 42622, 43200

43207 (PB—272761) **Foam glass insulation from waste glass. Final report.** Oakseson, W.G.; Lee, J.; Goyal, S.K.; Robson, T.; Cutler, I.B. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). Aug 1977. 140p. NTIS PC A07/MF A01.

Waste glass has proven to be effective for the production of foam glass insulation both in the bulk or rigid board form and pellet form. Problems inherent with the use of water, carbon black and calcium carbonate as the foaming agents, have been identified and many have been solved by various techniques. Water was found to be best suited for micrometer sized particles to 0.6 cm pellets, while carbon and CaCO3 yielded better products for larger objects. Large amounts of water can be rapidly incorporated into glass by using a sodium hydroxide (NaOH) solution in a heated autoclave. Smaller amounts can be incorporated into the glass by placing pellets formed by adding NaOH to a glass-clay mixture and directly heating in a furnace. The foaming process with carbon black was examined by analysis of the density, pore size, and open porosity of the foamed piece. Also, the addition of clay made foam glass less soluble to water.

43208 Recycling recovery reuse: an annual review feature. *Water Waste Treat.;* **21**: No. 3, 34-35(Mar 1978).

Material Recovery Ltd., the first company in the UK to salvage and reuse metal of the billions of cans discarded in Britain each year, is stepping up investment and research aimed at cutting imports of tin metal and iron ore and safeguarding the environment. The company's first ferrous extraction plant is processing domestic refuse at the rate of 100,000 tons/yr and extracting from it 6,000 tons of ferrous material. Material Recovery is starting a two-year development program to improve methods of cleaning ferrous scrap and preparing it for detinning. At present the British steel industry can absorb 100,000 tons of low grade scrap from uncleaned cans but, after cleaning and detinning metal recovered from at least 400,000 tons of used cans could be fully recycled. The company has now submitted proposals to another county council with the object of setting up a second extraction plant. The company is also negotiating currently with several other councils about building similar plants elsewhere in Britain.

43209 Air classified light fraction of shredded municipal solid waste. I. Composition and physical characteristics. Fan, D.N. (Howard Univ., Washington, DC). *Resour. Recovery Conserv.;* **1**: No. 2, 141-150(Oct 1975).

Using an average composition of municipal solid waste (MSW), a model of the air-classified light fraction (LF) of shredded MSW is proposed wherein the weight fraction of inorganic fines contained in the LF is proportional to $U^{1.3}$ where V is the velocity of the transport air. The LF model is used to compute calorific and ash content as a function of air classification and shown to be proportional to $U^{-1.3}$ for V less than 16 m/sec. The values calculated this way are consistent with limited available data. An important feature of the model is that the amount of inorganic fines in the LF is quantitatively expressed as a function of the effective air speed in an air classifier. The present LF model is applicable over a range of air-classifier speeds of practical interest and should be useful in future development and design for resource recovery processing.

43210 Recovery of non-ferrous metals by means of permanent magnets. Spencer, D.B. (Raytheon Service Co., Burlington, MA);

Schloemann, E. *Resour. Recovery Conserv.;* **1**: No. 2, 151-165(Oct 1975).

A technique for recovery of non-ferrous metals from municipal solid waste has been demonstrated. The technique may also be applied to separating non-ferrous metals from each other or to separating non-ferrous metals contained in automobile scrap. The apparatus has no moving parts and consumes no electrical power. It consists of an inclined ramp on which non-ferrour metals are deflected to one side as they slide down. Deflection results from eddy currents induced by permanent magnets embedded in the ramp surface. A detailed theory has been developed that allows to predict the deflection of metallic particles from the straight-down path as a function of all the relevant physical parameters. The deflection was measured on circular discs of aluminium, copper, zinc, brass, lead, and stainless steel as a function of the ramp inclination, disc thickness, disc diameter, distance of the discs to the magnet face, and initial velocity. Good agreement with theoretical predictions is observed in all cases. Tests have also been conducted on the heavy-fraction remaining after air classification of municipal solid waste. A laboratory separator has been tested at heavy fraction feed rates of 1 ton per hour which correspond to a feed rate of 15 tons per hour of municipal solid waste to a resource recovery plant. The concentration of non-ferrous metals contained in the heavy fraction is increased from 15 percent to 90 percent in a single pass with corresponding recovery efficiencies of 80 percent. Separator efficiency is given as a function of feed rate and moisture content.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

43211 (JACKFAU—76-137-5) **Fuel economy/cost relationships for future automobiles. Final report.** (Hittman Associates, Inc., Columbia, Md. (USA)). Jan 1976. 113p. Dep. NTIS, PC A06/MF A01.

Previous studies which focus on technologies to improve fuel economy provide adequate data on possible fuel economy gains as well as their costs as reflected in the manufacturer's suggested retail price to the consumer. The work described draws on these numerous studies to synthesize a relationship between: (1) technological options available to automakers for improving the fuel economy of their products; and (2) the cost of that product in future years as seen by the new automobile buyer in the context of potential government emissions and safety regulations. This study centers on the 1975—1990 time frame with most improvements assumed implementable by 1985. The intent is to provide a generalized automated ability to predict the response of automobile manufacturers to government policies encouraging fuel economy improvement in terms of the most likely change in cost for a given change in fuel economy.

INTERNAL COMBUSTION ENGINES

43212 (PB—275951) **Supplement to ambient temperature and vehicle emissions. Final report.** Eccleston, B.H.; Hurn, R.W. (Bureau of Mines, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Mar 1975. 58p. NTIS PC A04/MF A01.

A test program was conducted to study the effects of ambient conditions on exhaust emissions from a variety of automobiles. Twenty-six cars, ranging from 1967 models through catalytic converter-equipped prototypes and cars powered by unconventional engines (rotary, Diesel, and stratified charge), were tested at 20°, 50°, 75, and 110°F. Test procedure was the 1975 FTP, but with engine hoods closed and cooling air flow keyed to vehicle speed. HC, CO, NOx, total aldehydes, and reactive hydrocarbons, plus carbon balance fuel economy, were measured. From production cars and catalyst-equipped cars, '75 FTP composite emissions of all three gaseous pollutants were highest at 20°F. HC and CO were generally lowest at 75°F; composite values were greatly influenced by cold start (Bag 1) emissions. Composite NOx emissions were generally lowest at 110°F, and were relatively unaffected by ambient temperature. Fuel economy at 20°F was about 10% lower than at 110°F. The Diesel and stratified charge cars had low emissions and little temperature sensitivity. Use of air conditioners at 110°F caused higher emissions and about 10% lower fuel economy. Reactivity of HC emissions and aldehyde emissions were unaffected by temperature and were lower from catalyst-equipped cars at all temperatures.

SPARK-IGNITION

43213 (PB—274375) **Performance characteristics of automotive engines in the United States. Report number 9. Chrysler (1975) 225-cid 1-bbl engine. Interim report Jan—Feb 76.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. Contract DOT/TSC-RA-75-10. 39p. (BERC/OP—77/3). NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Chrysler 225-CID, 1-bbl engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

43214 (PB—274376) **Performance characteristics of automotive engines in the United States. Report number 10. Chevrolet (1975) 250 CID 1-bbl engine. Interim report Dec 75—Jan 76.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. Contract DOT/TSC-RA-75-10. 42p. (BERC/OP—77/4). NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Chevrolet 250-CID, 1-bbl engine to determine fuel consumption and emissions (hydrocarbons, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristics data required as input for engineering calculations involving ground transportation.

43215 (PB—274377) **Performance characteristics of automotive engines in the United States. Repot number 11. Chrysler (1975) 318-CID 2-bbl engine. Interim report Nov—Dec 75.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. Contract DOT/TSC-RA-75-10. 42p. (BERC/OP—77/5). NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Chrysler 318-CID, 2-bbl engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

43216 **Netherlands tests the practicality of heat pumps for domestic heating.** *Build. Technol. Manage.;* **16**: No. 5, 10-15(May 1978).

An experimental central-heating system is being installed in two semi-detached private houses in Veldhoven, a village near Eindhoven in the Netherlands. The system will consist of a small gas-fired Stirling engine driving the compressor of a heat pump. Together, the two parts will perform the same function as a conventional central-heating boiler. Experiments showed that a gas-fired Stirling engine/heat pump would have about twice the efficiency of a conventional gas-fired boiler. The new project is intended to gain further technical data to assess the technical and commercial viability of the system.

43217 **Ignition by plasma jet.** Weinberg, F.J. (Imperial Coll. of Science and Tech., London); Hom, K.; Oppenheim, A.K.; Teichman, K. *Nature (London);* **272**: No. 5651, 341-343(23 Mar 1978).

In order to improve the emission characteristics and efficiency of internal combustion engines, the trend is to leaner mixtures. Successful combustion at lower fuel : air ratios requires increased rates of flame propagation and, in spark-ignited engines, more effective and reliable ignition sources. Various avenues of research are being pursued towards these aims. One which shares the philosophy of radical injection with the work described is the stratified charge or torch-ignition concept. This is based on burning a rich mixture in a cavity small by comparison with the cylinder volume so that the free radicals generated therein are ejected into the main charge, there to increase the propagation rate in a leaner mixture. Flame propagation measurements were made in which the radicals were generated in the igniting plasma rather than by using chemical energy. The volume of the pre-chamber of the stratified charge or torch ignition concept was shrunk to a very small space within the plug, where a very high temperature, resulting in high ejection velocity, is produced by means of a small amount of electrical energy.

DIESEL

REFER ALSO TO CITATION(S) 43231, 43232

43218 (AD-A—046241) **Field tests of in-service modifications to improve performance of an icebreaker main diesel engine. Final report, November 1975—August 1976.** Kasel, E.A.; Newton, C.L.; Walter,

R.A. (Colt Industries, Inc., Beloit, Wisc. (USA). Fairbanks Morse Engine Div.). Aug 1977. Contract DOT-TSC-905. 109p. Fairbanks Morse Engine Division, Beloit, Wisconsin.

Field tests of in-service modifications to improve engine efficiency and lower the emissions were performed on the no. 3 main diesel engine of the USCGC Mackinaw (WAGB-83). This engine is a model 38D8-1/8 manufactured by Colt Industries, Fairbanks Morse Engine Division, and is rated for 2000 hp at 810 rpm. Baseline and modified engine tests were performed while the ship engaged in routine maneuvers of engine start, warm-up, docking, undocking and steady-steaming. The measurements performed included fuel consumption, smoke carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NOx), total hydrocarbons (THC), oxygen (O_2), engine speed and load, as well as important engine temperatures and pressures. The engine modifications were newer style pintle type fuel injector nozzles, shimmed injection pumps and advanced injection timing. These modifications decreased fuel consumption 1% to 3% depending on speed and load, reduced CO and THC up to 43% and 88% respectively and increased NOx up to 38%. Smoke emissions decreased 50% at low-load engine conditions and 5% at high-loads.

43219 (PB—274374) **Performance characteristics of automotive engines in the United States. Repot number 8. Mitsubishi Model 6DS7 diesel engine. Interim report Jul 75.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. Contract DOT/TSC-RA-75-10. 35p. (BERC/OP—76/33). NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of the Mitsubishi Model 6DS7 diesel engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen, and smoke) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

43220 (PB—274553) **Investigation of diesel-powered vehicle emissions. Part VII. Final report Jun 74—Nov 76.** Springer, K.J. (Southwest Research Inst., San Antonio, Tex. (USA)). Feb 1977. Contract EPA-68-03-2116. 407p. (SwRI-AR—1166). NTIS PC A18/MF A01.

Five light duty diesel vehicles and five heavy duty diesel engines were tested over various test cycles for both regulated and unregulated emissions. A Mercedes 220 D, Mercedes 240 D, Mercedes 300 D, Peugeot 2040, and an International Harvester pick-up truck with a Perkins 6-247 engine were the light duty diesel vehicles tested. The heavy duty diesels included a Detroit Diesel 6V-71 city bus engine with two injector designs, a Cummins NTC-290 truck engine operated with and without variable timing, and a Detroit Diesel 8V-71TA truck engine. Emissions measured included HC, CO, NOx, CO2, smoke, aldehydes, exhaust odor, benzo (a) pyrene, sulfate, sulfur dioxide, and particulate mass.

43221 **Oldsmobile try diesel power.** *Diesel Eng.;* **74**: No. 796, 10(Spr 1978).

The introduction of the Oldsmobile eight-cylinder diesel automobile in the U.S. is briefly discussed. The engines have shown reduced fuel consumption and cleaner exhaust emissions relative to comparable spark ignition engines. (PMA)

43222 **Quantification methods in solving thermoelastic problems.** Barbiero, R.; Garro, A. (Fiat, Torino, Italy). *Quad. Ric. Progettazione;* No. 12, 284-292(Nov 1977). (In Italian).

It is argued that, to solve thermoelastic problems, the theories of heat transfer and elasticity should be applied together. In this article these problems are dealt with by the finite element method. Examples of application to a turbine blade, a valve, a diesel engine, and a chemical reactor are considered. 23 refs.

TURBINE

REFER ALSO TO CITATION(S) 43222, 43230, 43233

43223 (PB—273052) **Improvements in non-reheat steam propulsion: retrofit and new construction. Final report.** (DeLaval Turbine, Inc., Trenton, N.J. (USA)). Sep 1977. Contract MA-6-38058. 249p. NTIS PC A11/MF A01.

Proposed improvements to major components and systems of non-reheat steam plants are investigated on an individual basis. Both technical and economic advantages and disadvantages are developed and identified. Selected individual components are then combined in several arrangements and the resulting systems evaluated with respect to fuel consumption and capital costs. Consideration is given to both new construction and retrofit applications. Additional details are given in Report PB-273 053.

43224 (PB—273053) **Improvements in non-reheat steam propulsion: retrofit and new construction. Appendix.** (DeLaval Turbine, Inc., Trenton, N.J. (USA)). Sep 1977. Contract MA-6-38058. 372p. NTIS PC A16/MF A01.

Proposed improvements to major components and systems of non-reheat steam plants are investigated on an individual basis. Both technical and economic advantages and disadvantages are developed and identified. Selected individual components are then combined in several arrangements and the resulting systems evaluated with respect to fuel consumption and capital costs. Consideration is given to both new construction and retrofit applications. Results are summarized in Report PB-273052.

43225 **When gas turbines go to sea their concept is still up in the air.** Pullin, J. *Engineer (London);* **246**: No. 6371, 42-43(4 May 1978).

The feasibility of using gas turbines for marine transport is considered. The advantages of gas turbines for aircraft (compactness, light weight, flexibility of operation, and fuel economy) should be transferable to marine applications. Recent research efforts in gas turbine technology are reviewed. (PMA)

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 43060

43226 (UCRL—80874) **Analysis of off-guideway energy storage/propulsion systems for dual mode transit systems.** Sacks, I.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Mar 1978. Contract W-7405-ENG-48. 25p. (CONF-780426—1). Dep. NTIS, PC A02/MF A01.

From Advanced Transit Association international conference; Indianapolis, IN, USA (25 Apr 1978).

Vehicles in dual mode systems may travel on civil streets in the densely populated central business districts and on dedicated fixed guideways on the runs to suburban areas. In the sparcely populated suburban districts, the vehicles in these dual mode systems have the option of returning to civil streets for flexible station access. Dual mode systems would be controlled by human operators off-guideway and be under automatic control on-guideway. Thus they offer the potential for flexible routing with the reduced cost of automated operation on long runs. In addition, on-guideway propulsion energy would be electrical and have all of the inherent advantages associated with central power supply systems. Some evaluation criteria and a method for combining these criteria for the selection of an energy storage/propulsion system for off-guideway operation of a dual mode transit system are presented. In addition, technical options for these energy storage/propulsion systems are discussed. These options are drawn from mechanical, chemical, and electrical energy storage systems. The selection criteria discussed are used to select "attractive" near term system option.

43227 (N—78-11889) **Research on battery-operated electric road vehicles.** Varpetian, V.S. Translated from *Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk;* **29**: No. 2, 43-50(1976). 21p. (NASA-TM—75142). NTIS PC A02/MF A01.

Mathematical analysis of battery-operated electric vehicles is presented. Attention is focused on assessing the influence of the battery on the mechanical and dynamical characteristics of dc electric motors with series and parallel excitation, as well as on evaluating the influence of the excitation mode and speed control system on the performance of the battery. The superiority of series excitation over parallel excitation with respect to vehicle performance is demonstrated. It is also shown that pulsed control of the electric motor, as compared to potentiometric control, provides a more effective use of the battery and decreases the cost of recharging.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 43156, 43226

VEHICLE DESIGN FACTORS

43228 (PB—274882) **Comparison of dynamometer power absorption characteristics and vehicle road load measurements.** Thompson, G.D.; Torres, M. (Environmental Protection Agency, Ann Arbor, Mich. (USA)). Jul 1977. 96p. (LDTP—77-3). NTIS PC A05/MF A01.

The report presents vehicle road load force versus speed curves and Clayton dynamometer force versus speed curves. The vehicle road load force data were collected in the recent road load project, where the vehicle road load, as a function of speed, was determined for sixty-three light-duty vehicles. The dynamometer

data were obtained from the six EPA certification dynamometers. This data is first used to generate an equation to represent an average emission dynamometer. The variations of the individual dynamometers about this average dynamometer curve are discussed. Subsequently, each vehicle curve is compared to this average dynamometer curve. Variations between different vehicles are discussed, and the possible intrinsic error caused by differences between the shape of the dynamometer force versus speed curve and the typical vehicle road load curve is investigated.

BODY AND CHASSIS

43229 (PB—274863) **Rolling resistance of truck tires as measured under equilibrium and transient conditions on Calspan's Tire Research Facility. Final report.** Gusakov, I.; Schuring, D.J.; Kunkel, D. (Calspan Corp., Buffalo, N.Y. (USA)). Oct 1977. 212p. (CALSPAN-ZM—5947-T). NTIS PC A10/MF A01.

A test program to measure the rolling resistance characteristics of selected 11 x 22.5 truck tires was conducted at the Calspan Tire Research Facility (TIRF). Test data from this study provide a data base which contributes to the understanding of truck tire rolling resistance and its relationship to operating variables. The influences of tire wear, speed, load, torque, slip angle, inflation pressure, temperature, carcass construction, tread pattern and distance traveled on rolling resistance were investigated. A short description of the test program and a brief summary of the results are included.

ENGINE SYSTEM

43230 (DOE/NASA/1011—78/23) **Experimental evaluation of fuel preparation systems for an automotive gas turbine catalytic combustor.** Tacina, R.R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1977. Contract EX-76-A-31-1011. 21p. (NASA-TM—78856). Dep. NTIS, PC A02/MF A01.

Premixing-prevaporizing fuel systems were evaluated for use with a catalytic reactor for possible automotive gas turbine application. Spatial fuel-air distributions, degree of vaporization, pressure drop and air velocity profiles were measured. Three airblast injectors and an air-assist nozzle were tested. Air swirlers were used to improve the spatial fuel-air distribution. The work was done in a 12 cm tubular duct. Test conditions were: a pressure of 0.3 and 0.5 MPa, inlet air temperatures (up to 800°K, air velocities of 10 and 20 m/s and fuel-air ratios up to 0.020. The fuel was Jet A. The best results were obtained with an air-blast configuration that used multiple cones to provide high velocity air for atomization and also straightened the inlet airflow. With this configuration, uniform spatial fuel-air distributions were obtained with mixing lengths greater than 17.8 cm. In this length, vaporization of the fuel was 98.5% complete at an inlet air temperature of 700°K. The total pressure loss was 1.0% with a reference velocity of 20 m/s and 0.25% at 10 m/s. The air velocity was uniform across the duct and no autoignition reactions were observed.

43231 **Anglo-Belgian DZ range.** *Diesel Eng.;* **74**: No. 796, 5-9(Spr 1978).

A description is given of the design of a new series of 220 kW per cylinder diesel engines for marine propulsion, marine and industrial power generation, and rail traction applications. The design is aimed particularly at achieving quiet operation, low fuel and lubricating oil consumption, reliability, and easy maintenance. (PMA)

43232 **New Deutz medium-speed design.** *Diesel Eng.;* **74**: No. 796, 25-27(Spr 1978).

The design of an economical diesel engine for both marine and stationary applications is described. Operating economy is characterized by the following criteria: (1) low fuel and lubricating oil consumptions; (2) long service life and reliability; (3) ease of maintenance and operation; (4) negligible environmental nuisance by exhaust and noise emissions; and (5) optimum adaptation to individual applications. On the testbed, the eight-cylinder in-line prototype showed a low fuel consumption of about 209 g/kWh at full load on 41.9 kJ/g gas oil, equivalent to a thermal efficiency of 41%.

43233 **New materials of high temperature turbines: ONERA DS composites confronted with the blade problems.** Bibring, H. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). *Entropie;* **14**: No. 79, 35-44(1978). (In French).

The problem of advanced aircraft turbines operating at higher temperature does immediately raise the question: are there new materials available required for such a realization. ONERA's refractory DS composites answer the question. These materials are not a laboratory invention looking for an eventual application; on the contrary they represent the outcome of a research work directed precisely to new materials for better and more reliable turbine blades in advanced aircraft engines. The needs required for a blade material in aircraft turbines operating at higher temperatures are compared with the actual performance as found on Cotac DS composites testing. The structure and the properties of the more fully developed 74 and 741 types are specified. In particular, the high temperature structural stability, the impact of thermal and mechanical fatigue, the oxidation resistance and the coating capability are more thoroughly evaluated. The great benefit in operational temperature of these materials can be immediately exploited in the field of uncooled solid blades. The problem of cooling passages in DS eutectic blades is also outlined.

EMISSION CONTROL

43234 (PB—275763) **Development of revised light-duty-vehicle emission—average speed relationships.** Smith, M.; Aldrich, T. (Olson Labs., Inc., Anaheim, Calif. (USA)). Aug 1977. Contract EPA-68-03-2222. 252p. NTIS PC A12/MF A01.

This report presents the results entitled 'Development of Revised Light-Duty Vehicle Emission Average Speed Relationships.' The two-fold purpose of the program was (1) to perform a statistical analysis of the GM chase-car data, and (2) to establish regressions of fuel consumption and emissions on average speed over driving cycles generated from combined GM and CAPE-10 data. Ten cycles were selected at each of 11 nominal speeds ranging from 5 mph to 55 mph. Hot-start estimates of HC, CO, NOx (all in units of grams per mile), and fuel consumption (in units of miles per gallon) over each of the cycles were obtained for each of 18 model-year groups. The emissions and fuel consumption estimates were regressed on average speed to yield the desired emission-average speed relationship for each model-year group. The equations were then normalized to 19.6 mph, the average speed over the FTP cycle, to yield correction-factor equations. Groups were combined to give composite correction-factor equations for 1975 vehicle population in low-altitude cities and for 1974 vehicle population in high-altitude cities.

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 43218, 43237, 43238

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 43218, 43237, 43238

HYDROCARBONS

REFER ALSO TO CITATION(S) 43218, 43237, 43238

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 43226

43235 (AD-A—047355) **Performance evaluation of a catalytic partial oxidation hydrogen generator using turbine engine fuels. Final report 1 Oct 76—30 Apr 77.** Clayton, R.M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). Oct 1977. 43p. NTIS PC A03/MF A01.

Operation of a catalytic partial oxidation reactor under simulated turbine engine idle power air state conditions, using a conventional aviation turbine fuel (JP-5) and an unconventional fuel (blend of JP-5/xylene), is shown to produce a 'fuel gas' stream of near theoretical equilibrium composition at very fuel-rich A/F ratios in the range of 5.0-5.6. The combustibles in the fuel gas comprise about 6% H_2 and 93% CO by mass and therefore the fuel gas exhibits superior lean-burning qualities relative to the fuel gas exhibits superior lean-burning qualities relative to the fuel feed stock. The concept of using the very fuel-rich partial oxidation process as a first stage of a two-stage combustion system for onboard processing of broadened specification fuels to improve their combustion characteristics is discussed. For the nonoptimal reactor design used, excessive catalyst bed temperatures and a propensity for solid carbon deposition in the bed were observed. These phenomena are not fully understood and need further elucidation. Thermal reactor schemes (without catalysts) may be more advantageously applied to aviation turbine engines but these schemes also require additional investigation to delineate design requirements.

43236 (AD-A—047659) **Evaluation of the extended use of ferrocene for test cell smoke abatement; engine and environmental test results. Interim report.** Klarman, A.F. (Naval Air Propulsion Test Center, Trenton, N.J. (USA). Propulsion Technology and Project Engineering Dept.). Oct 1977. 122p. (NAPTC-PE—110). NTIS PC A06/MF A01.

Results of a test program to evaluate the feasibility of utilizing the smoke suppressant fuel additive, ferrocene, during post overhaul performance checks of gas turbine engines at Naval Air Rework

Facilities (NARF's) and other lower level maintenance test facilities to reduce test cell exhaust smoke plumes to environmentally acceptable levels are presented. This test program was conducted on the following gas turbine engines: J52-P-6B, J57-P-10, J79-GE-8D, TF30-P-6C and TF41-A-2A.

43237 (BERC/RI—78/2) **Performance of gasoline and diesel fuels produced from COED syncrude.** Bechtold, R.L.; Fleming, R.D. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jun 1978. 26p. Dep. NTIS, PC A03/MF A01.

Fuel consumption and exhaust emissions characteristics were evaluated for gasoline and diesel fuel produced from coal liquid derived syncrude. The engine types used were: (1) current technology spark-ignition, homogeneous charge, (2) stratified-charge, and (3) Stirling. There were no significant changes in fuel consumption or exhaust emissions between syncrude-derived fuels and conventional fuels in stratified-charge and Stirling engines. Because of its low (approximately equal to 70) octane number and volatility, the synthetic gasoline required a reduction in compression ratio to achieve knock-limited, MBT spark timing. This was in comparison to the reference gasoline, in a single-cylinder spark-ignited test engine, at one speed/load point. Exhaust emissions were very similar between the two fuels.

43238 (COO—4248-1) **Passenger car fuel economy in short trip operation. Technical progress report, May 1, 1977—November 30, 1977.** Phoebe, C.H. (Gulf Research and Development Co., Pittsburgh, Pa. (USA)). Nov 1977. Contract EC-77-C-02-4248. 25p. Dep. NTIS, PC A02/MF A01.

Studies to define fuel utilization in highway transportation have consistently shown that the fuel used in starting and driving the first few miles of any trip is disproportionally large when compared to the fully warmed up fuel economy. The program described was devised to provide a base line for subsequent studies of short-trip fuel economy that will eventually be needed to evaluate alternative power plants and fuels. The immediate objective is the evaluation of methods devised to provide improved fuel utilization and compare conventional gasoline with a special fuel blend aimed at improved short-trip economy. A technical progress report is given that outlines the test design, selection of the fuel blends, driving cycle, operating procedure, test equipment, selection of the test vehicles, and data handling methods. It covers the period May 1, 1977 to November 30, 1977. The test work involving the fuel consumption measurements on four vehicles operated on a chassis dynamometer at 0°F and 90°F is complete.

MATERIALS

43239 **Automated measurement of self-diffusion coefficients by the spin-echo method.** Cantor, D.M.; Jonas, J. (Univ. of Illinois, Urbana). *J. Magn. Resonance;* **28**: 157-162(1977).

A computer-controlled automated system for the measurements of the self-diffusion coefficients, D, using the fixed field gradient spin-echo method has been developed. The system automatically generates and optimizes the pulse sequences and measures D. Accuracy and precision of the automated diffusion measurements are discussed.

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 42113, 42122, 42123

43240 (CONF-770833—(Absts.)) **Catalysis, surface dynamics, plasma polymerized thin films.** (Missouri Univ., Rolla (USA)). 1 Aug 1977. 48p. Univ. of Missouri, Rolla.

From 4. conference on surface properties of materials; Rolla, MO, USA (1 Aug 1977).

Abstracts of the conference papers are presented. Topics covered include catalysis, surface dynamics, plasma polymerized thin films and surface analysis. 25 abstracts are included. (GHT)

43241 **Applications of color in metallography and photography.** Crouse, R.S.; Gray, R.J.; Leslie, B.C. (Oak Ridge National Lab., TN). pp 43-64 of Interpretive techniques for microstructural analysis. McCall, J.L.; French, P.M. (eds.). New York; Plenum Publishing Corp. (1977).

Color photography as applied in a metallography laboratory has moved out of the realm of a laboratory curiosity into one of considerable utility. In some instances there is just no substitute for recording our observations in color. The increased microstructural contrast and analytical information provided by interference films on metallographic specimens demand it. The current state of photographic technology makes it possible for even small labs to indulge in color to a certain extent. Good cameras and speedy, reliable commercial film processing are the tools, and they are available. They are not unbearably expensive and the end results are worth the little added effort.

43242 **Issledovanie i primenenie splavov reniya. (Investigations and uses of rhenium alloys).** Savitskii, E.M.; Tylkina, M.A. (eds.). Moscow; Izdatel'stvo Nauka (1975). 195p.

Articles are compiled on the metallurgical processing of Re and the use of Re and its alloys in new technologies. The results of studies on the physical-chemical interactions of Re with other elements, binary and ternary phase diagrams, and the properties and fabrication of new compositions of alloys are reported. Individual abstracts were prepared for selected articles. (JSR)

PREPARATION AND FABRICATION

43243 (AD-A—047485) **Effect of solute redistribution on the structure and properties of cast alloys: peritectic solidification and model of continuous casting. Technical report.** David, S.A.; Mathew, J.; Brody, H.D. (Pittsburgh Univ., Pa. (USA). Dept. of Metallurgical and Materials Engineering). Oct 1977. Contract N00014-75-C-0800. 54p. (SETEC-MME—77-110). NTIS PC A04/MF A01.

Two papers presented at the Sheffield International Symposium on Solidification are included. One paper covers a theory to describe the relation between casting conditions and structure in directionally solidified peritectic alloys. Experiments on Pb-Bi and Sn-Cd alloys are used to check the theory. The second paper describes the application of a computer model of continuous casting to study the effects of ingot diameter and casting rate on heat flow and thermal stresses in an aluminum-magnesium alloy. (Author)

43244 (CONF-780427—1) **Flaw location and characterization in anisotropic materials by ultrasonic spectral analysis.** Adler, L.; Cook, K.V.; Simpson, W.A.; Lewis, D.K. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Conference of the American Society for nondestructive testing; New Orleans, LA, USA (3 Apr 1978).

A method of quantitatively determining size and location of flaws in anisotropic materials such as stainless steel welds is described. In previous work, it was shown that spectral analysis of a broad band ultrasonic pulse scattered from a defect can be used to determine size and orientation in isotropic materials if the velocity of sound in the material is known. In an anisotropic structural material (stainless steel weld, centrifugal cast pipe), the velocity (both shear and longitudinal) is direction-dependent. When anisotropy is not taken into account, defect location and defect size estimation is misjudged. It will be shown that the effect of this structural variation in materials must be considered to obtain the correct size and location of defects by frequency analysis. A theoretical calculation, including anisotropy, of the scattered field from defects will also be presented.

43245 (K—1894) **Electrodeposition of nickel onto steel using a soluble mobile anode.** Petit, G.S.; Wright, R.R. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Apr 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

During the Cascade Improvement Program (CIP), a number of component parts that have been in service for many years will be reused. Many of these parts will have exposed steel from loss of nickel plate or mechanical damage. A good method is needed to patch small areas of exposed steel with electroplated nickel to inhibit the corrosive attack of uranium hexafluoride (UF_6) on the steel. A method to patch bare plate steel with nickel, using a mobile soluble anode, has been developed by the K-25 Technical Services Division. This report describes the method and presents test results of coupons plated by the method.

43246 (N—77-31214) **M551 metals melting experiment. Final report.** Busch, G. (Grumman Aerospace Corp., Bethpage, N.Y. (USA). Research Dept.). Jan 1977. Contract NAS8-28728. 29p. (NASA-CR—150383; RE—536). NTIS PC A03/MF A01.

Electron beam welding studies were conducted in the Skylab M551 metals melting experiment, on three different materials; namely 2219-T87 aluminum alloy, 304L stainless steel, and commercially pure tantalum (0.5 wt % columbium). Welds were made in both one gravity and zero gravity (Skylab) environments. Segments from each of the welds were investigated by microhardness, optical microscopy, scanning microscopy, and electron probe techniques. In the 2219-T87 aluminum alloy samples, macroscopic banding and the presence of an eutectic phase in the grain boundaries of the heat affected zone were observed. The stainless steel samples exhibited a sharp weld interface and macroscopic bands. The primary microstructural features found in the tantalum were the presence of either columnar grains (ground base) or equiaxed grains (Skylab). The

factors contibuting to these effects are discussed and the role of reduced gravity in welding is considered.

43247 (RFP—2790) **Electrochemical machining.** Fuller, J.E. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 19p. (CONF-780532—1). Dep. NTIS, PC A02/MF A01.

From Rocky Mountain quality technical seminar; Denver, CO, USA (19 May 1978).

The process of electrochemical machining is explained, tool configurations are shown, and examples of the type of work that can be done are given. Advantages of the process are discussed. (GHT)

43248 (UCID—17764) **Casting and arc-melting techniques for preparing lithium anodes.** Parrish, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Apr 1978. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The lithium/air battery has potential as a power source for full-performance electric automobiles. However, fabricating the lithium alloy anodes for this battery presents a challenge. We have experimented with casting and arc-melting techniques for making lithium alloy anodes. Casting is difficult because molten lithium does not pour well; also, once poured, it adheres to the mold and is difficult to remove. Arc-melting, a relatively simple procedure, seems to eliminate both problems.

43249 Experimental evaluation of half bead weld repairment for nuclear pressure vessels. Yada, T.; Ishikawa, K. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). pp 527-537 of Fracture mechanics and technology. Volume 1. Proceedings of an international conference held at Hong-Kong, 21-25 Mar 1977. Sih, G.C.; Chow, C.L. (eds.). Alphen aan den Rijn, Netherlands; Sijthoff (1977).

From Conference on fracture mechanics and technology; Hong Kong, China (21 Mar 1977).

An experimental study of half bead welding used in nuclear reactor pressure vessel construction is carried out to evaluate the metallurgical structure, residual stress and toughness of weldment and heat affected zone. Residual stresses developed during welding are at the level normally expected for the usual welding. But, metallurgical structure at heat affected zone is well recrystallized and have a good ductility by Charpy Notch Test and double notch test.

43250 Kinetics of electrochemical incorporation of lithium into aluminium. Melendres, C.A. (Argonne National Lab., IL). *J. Electrochem. Soc.;* **124**: No. 5, 650-655(May 1977).

The electrochemical incorporation of lithium into aluminum was investigated by chronocoulometric, galvanostatic, and potentiostatic techniques. Results of the chronocoulometric measurements were interpreted in terms of the theory developed by Astakhov. Incorporation of lithium to form the solid solution α-phase is limited by its rate of diffusion into aluminum, with a measured diffusion coefficient of about 4×10^{-10} cm^2/sec at 450°C. Implantation at potentials where a layer of intermetallic compound forms on the electrode surface was found to be limited initially by the reaction to form the compound LiAl (β-phase) and subsequently by the rate of lithium diffusion into the growing β-phase layer. The results of galvanostatic transient measurements indicate a diffusivity of lithium in β-LiAl of the order of 10^{-8} cm^2/sec and a fast charge transfer step. The initial steps in the formation of the intermetallic compound appear to involve typical electrocrystallization (i.e., nucleation and growth) processes.

43251 Application of high rate magnetron sputtering to the fabrication of A-15 compounds. Kampwirth, R.T.; Hafstrom, J.W.; Wu, C.T. (Argonne National Lab., IL). *IEEE Trans. Magn.;* **13**: No. 1, 315-318(Jan 1977).

High quality Nb_3Sn films have been fabricated using a recently developed magnetron sputtering process capable of deposition rates approaching 1 μm/min at sputtering voltages less than 500 V and power levels of about 5 KW. Low sputtering voltages allow more complete thermalization at lower pressures of the material condensing on the substrate which can improve long range order. Transition temperatures of up to 18.3°K, J/sub c/(0)'s of 15 x 10^6 A/cm^2 and Hc_2 as high as 240 k0e have been achieved in 1-3 μm films deposited from a Nb_3Sn reacted powder target with substrate temperatures between 600 and 800°C. The films exhibit smooth surfaces and, generally, a (200) preferred orientation. The growth of the film is columnar in nature. The sputtering parameters, substrate material and temperature will be related to film structure, T/sub c/ and J/sub c/(H,T) and the Nb/Sn ratio as determined by Rutherford backscattering.

43252 Determining full-field strain distributions in hot rolled billets by simulation. Burger, C.P.; Oyinlola, A.K.; Scott, T.E. (Iowa State Univ., Ames). *Met. Eng. Q.;* 21-27(May 1976).

An experimental technique, termed photoplasticity, was employed to examine the three-dimensional strain distribution in rolled billets. In particular, a 60 : 40 mixture of flexible and rigid polyester resins, which exhibits visible light birefringence at strains beyond the elastic limit, was used as the photoplastic material. When deformed at 40°C, this material simulates, at least in the first approximation, characteristics of aluminum when it is deformed at about 425°C. Furthermore, distribution of principal shear strains determined from fringe patterns of rolled blocks of the photoplastic material exhibited features which could be related to edge contours known to form during commercial hot rolling of aluminum. This relatively new technique offers exciting investigative possibilities in the field of deformation processing.

43253 Simplified hot rolling load calculations incorporating material strain rates. Popoff, A.A. (Los Alamos Scientific Lab., NM). *Int. J. Mech. Sci.;* **18**: 529-532(1976).

Hot rolling theory is briefly reviewed, and the use of a simplified method for calculating roll separating forces, which incorporates an approximation for the variation of flow stress as a function of strain rate, is discussed. Calculations of rolling loads for different samples and different conditions of strip inlet temperature, roll surface temperature, and strip reduction are included in an attempt to reproduce measured values. Agreement between these calculations and measured values for these different samples and conditions ranged from 12 to 33 percent.

43254 Materials in CANDU reactors and constraints on supply. Zabrodsky, J. (Noranda Metal Industries Limited, Special Metals Division). pp 18 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976. Montreal, Canada; Ecole Polytechnique ([nd]).

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

Supply problems and fabrication methods for materials in the CANDU steam supply system are detailed.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 42799, 43299

43255 (COO—4385-2) **Pore shrinkage and Ostwald ripening in metallic systems. Progress report, July 1, 1977—June 30, 1978.** Kuczynski, G.C.; Allen, C.W. (Notre Dame Univ., Ind. (USA)). Feb 1978. Contract EG-77-S-02-4385. 11p. Dep. NTIS, PC A02/MF A01.

A new theory of Ostwald ripening (the coarsening of particles in a matrix or on a substrate) is being developed, which is based on the principle of minimum entropy production. This theory yields particle size distribution functions whose general shape is in much closer agreement with existing observations than is that of well established theories. Progress is reported both in the theoretical development and in several areas of experiment. The goal of the experimental program is the determination of actual distributions from very large numbers of size measurements, in order to provide statistically more significant basis for comparison with the various theories than has previously characterized such measurements.

43256 (LBL—7325) **Texture of directionally solidified Al—$CuAl_2$ eutectic alloy.** Valero, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 78p. Dep. NTIS, PC A05/MF A01.

Thesis.

An experiment was conducted to determine the texture of an Ai-$CuAl_2$ eutectic alloy unidirectionally solidified at 12.9 μm/s under a temperature gradient of 70.7°C/cm. Directional solidification produced a parallel well aligned microstructure with an interlamellar spacing of 2.73 μm. The lamellae exhibited a strong preferred orientation or texture. An x-ray diffractometer method was used to obtain the data and pole figures corresponding to each of the two solid phases were plotted. The pole intensities were represented in terms of "times random" units.

43257 (N—7732283) **Effects of heat treating pm Rene' 95 slightly below the gamma' solvus.** Dreshfield, R.L. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1977. 19p. (NASA-TM-X—73663; E—9183). NTIS PC A02/MF A01.

An investigation was performed on as-hot-isostatically-pressed (As-HIP) Rene' 95. This study was made in order to obtain information on the variation of the gamma prime phase .with solution temperatures near the gamma prime solvus temperature and the resulting effects on tensile and stress rupture strenght. The change in the amount of gamma prime phase with decreasing solution temperature was observed to be primarily associated with decreasing solubilities of Al+Ti+Nb and increasing solubility of Cr in the gamma phase.

43258 Acoustic phonons in $SnSe_2$. Brebner, J.L. (Univ. of Montreal); Jandl, S.; Powell, B.M. *Nuovo Cim., B;* **38**: No. 2, 263-270(11 Apr 1977).

From International conference on layered semiconductors and metals; Bari, Italy (6 Sep 1976).

Results of a measurement of the acoustic phonon dispersion curves in the semiconducting layer structure $SnSe_2$ are presented. The measurements were made at the NRU reactor, Chalk River, by the technique of coherent inelastic neutron scattering. For modes propagating along the c*-direction both the LA and the doubly degenerate TA branches were measured. At the zone boundary the observed frequencies are (1.09 +- 0.04) THz (LA) and (0.71 +- 0.03) THz (TA). For modes propagating along [100] and [110], the LA branch and the TA branch with modes polarized predominantly along c were measured. A group-theoretical analysis of the phonon symmetries is given for the major symmetry points in the zone, and the corresponding atomic displacements for the atoms composing a layer are derived. By assuming rigid layers the results are analysed to obtain a value for the interlayer interaction. This is compared with corresponding values obtained from the acoustic dispersion curves of other layered structures.

43259 Neutron spectroscopy of low-frequency phonons in solid Hg. Kamitakahara, W.A.; Smith, H.G.; Wakabayashi, N. (Oak Ridge National Lab., TN). *Ferroelectrics;* **16**: 111-114(1977).

Extensive measurements of the phonon dispersion curves of trigonal mercury have been carried out by neutron inelastic scattering. Some transverse branches of the phonon spectrum have very low frequencies, as small as 0.9 meV at the zone boundary, compared with a maximum lattice frequency of 15 MeV. The data have been accurately fitted with an 8-neighbor Born-von Karman model, and a reliable phonon density of states $F(\omega)$ has been calculated. Comparison with $\alpha^2(\omega)F(\omega)$ derived from tunneling measurements reveals a substantial increase in $\alpha^2(\omega)$ at low frequencies. Direct calculation of alpha$^2(\omega)F(\omega)$ from the BvK model, assuming a simple form for the electron-phonon matrix element, gives lambda = 2.0 compared with lambda = 1.6 from tunneling. We discuss the origin of the frequency dependence of $\alpha^2(\omega)$.

43260 Raman scattering near the tricritical point in SbSI. Peercy, P.S. (Sandia Labs., Albuquerque, NM). *Ferroelectrics;* **16**: 193-197(1977).

Measurements of the temperature and pressure dependences of the Raman spectra of the semiconducting ferroelectric SbSI indicate that the transition, which is first order at atmospheric pressure, becomes second order for p greater than or approximately equal 1.4 kbar. Raman scattering near this tricritical point is discussed in terms of a Landau series expansion of the free energy.

43261 Neutron study of the antiferromagnetic order in Cr—Si alloys. Cable, J.W. (Oak Ridge National Lab., TN). *J. Magn. Magn. Mater.;* **5**: 112-115(1977).

Neutron diffraction measurements were made on polycrystalline Cr-Si alloys containing 0.90, 1.37, 1.85 and 2.74 at. percent Si to establish the types of antiferromagnetic order in this system. The results show that three types of antiferromagnetic order occur in this concentration range. Below 1 at. percent Si the behavior is similar to that of pure Cr with a transversely polarized spin density wave at high temperatures and a spin-flip to longitudinal polarization at low temperatures. Above 1.8 at. percent Si only the commensurate structure develops while both the commensurate and incommensurate structures occur in the intermediate concentrations. The magnitude of the modulation wave vectors and also the average moments increase with increasing Si content. Within the rigid-band extension of the Fermi surface "nesting" model of Cr this implies that Si behaves as an electron donor in Cr.

43262 Metallography and electron microprobe analysis in brazing alloy remelt studies. Canonico, D.A.; Henson, H.M.; Henson, T.J.; Crouse, R.S. (Oak Ridge National Lab., TN). *Microstruct. Sci.;* **5**: 287-299(1977).

In selecting a brazing alloy, the remelt temperature is often of interest because of the desire to have the brazement stand a temperature higher than brazing temperature. Ideally, the braze is made at a low temperature and, after brazing, the melting point of the base metal determines the upper temperature of the system. A program has been developed at ORNL with two main objectives: (1) the remelt temperature of a number of alloys which covers a broad range of temperatures, and (2) the mechanism through which the increase in melting point of the filler metal is accomplished. The studies have been with three alloys developed for brazing refractory materials: (1) Ti—48 percent Zr—4 percent Be, (2) Ti—46 percent Zr—8 percent Ge, (3) Ti—25 percent Cr—21 percent V. All three possess excellent flowability and wettability. Miller-Peaslee specimens of tantalum were prepared and tested under closely controlled conditions of joint opening, brazing temperature, and vacuum.

43263 Metallographic study of ferrite—sigma transformation using ferromagnetic colloid, microprobe analysis, and color etching. Gray, R.J.; Crouse, R.S.; Sikka, V.K.; King, R.T. (Oak Ridge National Lab., TN). *Microstruct. Sci.;* **5**: 65-84(1977).

The mechanical properties of ferrite-containing austenitic stainless steel base metal and weldments are usually adversely affected by prolonged exposure to temperatures in the 482-900C (900-1652F) range. One cause of the property alteration is related to the transformation of relatively ductile delta-ferrite to less ductile sigma-phase. Attempts to identify sigma and delta ferrite phases by color staining techniques alone are well documented; however, the results are often questionable due to the difficulty in maintaining consistent color identification. This investigation is concerned with the microstructural responses of the ferromagnetic delta-ferrite phase and the paramagnetic sigma-phase to a ferromagnetic iron colloid in a magnetic field. Such positive or negative responses of the two phases to the colloid offer a more definitive identification. With this technique, the identification of small amounts of these phases in the microstructure is limited only by the highest magnification and resolution of the optical microscope. The procedure is substantiated in this metallographic study with microprobe analysis and color metallography. Several examples of the correlative use of these three techniques in identifying varying amounts of delta-ferrite → sigma transformation are presented.

43264 Angular resolved AES and LEED studies of O and S adsorption on the Cu(100). Noonan, J.R.; Zehner, D.M.; Jenkins, L.H. (Oak Ridge National Lab., TN). *Surf. Sci.;* **69**: 731-734(1977).

Studies of angular resolved Auger electron spectra from the Cu(100) have been extended to examine the effects of ordered overlayers of oxygen or sulfur on the 62 eV Cu $M_{2,3}$ VV emission. Preparation and cleaning of samples and the determination of Auger electron intensity distributions from the adsorbate-covered surface employed methods previously described.

43265 Calculation of habit planes for elastic transformations by minimization of their elastic strain energy. Clarke, D.R. (Univ. of California, Berkeley). *Metall. Trans., A;* **7**: 723-730(May 1976).

By using Eshelby's method for the determination of the stresses and strains generated in a transformation, the shape and orientation of an ellipsoidal region of transformed phase that minimizes the elastic strain energy accompanying the transformation are calculated together with the change in elastic strain energy. The orientation of minimum total energy describes the habit plane. The applicability of the approach is demonstrated by showing that the habit planes of twins in cubic crystals, and martensitic plates in In-20 percent Tl and Fe-31 percent Ni, which have been calculated by other methods, can alternatively be determined by this method. It is then used to calculate that the habit plane for martensitic plates in bulk, high density, oriented orthorhombic polyethylene should be (-4.67,1,0). As a consequence of these calculations it is shown that minimization of the total elastic strain energy must be the dominating factor in the nucleation event of transformed products in most metals.

43266 Phase transformation and stabilization of a high strength austenite. Jin, S. (Univ. of California, Berkeley); Huang, D. *Metall. Trans., A;* **7**: 745-751(May 1976).

An investigation of the phase transformation and the austenite stabilization in a high strength austenite has been made. An Fe-29Ni-4.3Ti austenite age-hardened by $\gamma'(Ni_3Ti)$ precipitates showed a further increase of strength after martensitic and reverse martensitic phase transformations. The stability of ausaged austenite as well as ausaged and transformation-strengthened austenite was improved significantly through an isothermal treatment at 500°C. The M/sub s/ temperature of the strengthened austenite was restored to nearly that of annealed austenite while the austenite was hardened to R/sub C/ 41 through precipitation and phase transformations. The observed austenite stabilization is attributed to the formation of G.P. zones or short-range order of less than approximately 10 A size.

43267 Some recent developments in martensitic transformations. Wayman, C.M. (Univ. of Illinois, Urbana). pp 159-170 of Proceedings of the first JIM international symposium on "new aspects of martensitic transformation". Sendai, Japan; Japan Inst. of Metals (1976).

From 1. JIM international symposium on "new aspects of martensitic transformation"; Kobe, Japan (10 May 1976).

After comments on the status of martensite crystallography, nucleation, pretransformation effects, morphology, abnormal tetragonality, martensite→martensite transformations, and the shape memory effect, attention is drawn to a discussion of some characteristics and uncertainties of thermoelastic martensitic transformations, a rekindled area of interest.

43268 Quasicrystalline approximation: comparison of the spectral density with exact results. Hall, D.G. (Univ. of Tennessee, Knoxville). *Solid State Commun.;* **20**: 509-512(1976).

The quasicrystalline approximation (QCA) for electronic excitations in a one-dimensional liquid metal is examined by comparing the spectral density A(k, E) to exact numerical results. The numerical method is briefly described and the limitations of the QCA are indicated.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 42764, 42872, 43249, 43306, 43307

43269 (AD-A—047420) **Fatigue crack propagation resistance of beta-annealed Ti—6Al—4v alloys of differing interstitial oxygen contents. Final report.** Yoder, G.R.; Cooley, L.A.; Crooker, T.W. (Naval Research Lab., Washington, D.C. (USA)). 4 Oct 1977. 17p. (NRL—8166). NTIS PC A02/MF A01.

Fatigue crack growth rates have been determined for beta-annealed Ti—6Al—4V alloys with respective oxygen contents of 0.06, 0.11, 0.18, and 0.20 weight percent. For each of these alloys, transitional crack growth behavior has been observed which appears to correlate with a critical value of the reversed plastic zone size: the Widmanstaetten packet size. Moreover, growth rates below transitional levels order in terms of packet size. The present results suggest that interstitial oxygen content and prior beta grain size significantly affect fatigue crack growth rates through control of the Widmanstaetten packet size.

43270 (ANL/MSD—77-8) **Compilation of elevated-temperature, strain-controlled fatigue data on Type 316 stainless steel.** Diercks, D.R. (Argonne National Lab., Ill. (USA)). Oct 1977. Contract W-31-109-ENG-38. 30p. AT.

Available strain-controlled elevated-temperature fatigue data on Type 316 stainless steel are tabulated. The tabulated data were obtained at laboratories in the United States, Great Britain, and Japan. These data include 379 observations under zero- and tension-hold-time conditions and 10 observations under compression and tension plus compression hold-time conditions. The experimental procedures and specimen designs used to obtain these data are also discussed briefly.

43271 (ANL/MSD—78-4) **Compilation of United States and British elevated-temperature, strain-controlled fatigue data on Type 316 stainless steel.** Diercks, D.R. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 27p. AT.

The present report represents an attempt to collect and tabulate available United States and British strain-controlled elevated-temperature fatigue data on Type 316 stainless steel. These data include 324 observations under zero- and tension-hold-time conditions and 10 observations under compression and tension plus compression hold-time conditions. The experimental procedures and specimen designs used to obtain these data are also discussed briefly.

43272 (CONF-780540—1) **Creep-recovery constitutive equation and its time-independent limit.** Chang, S.J. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1978. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

From 9. southeastern conference on theoretical and applied mechanics; Nashville, TN, USA (4 May 1978).

The effect of strain recovery is taken into consideration in establishing a constitutive equation for metals at elevated temperatures. Internal state variables and Rice's flow potential are used in the representation. Growth law for the state variables is discussed and interpreted to be a more general form of the kinematic hardening condition. Yield condition is obtained from the flow law. Accordingly, the flow rule is established with the effect of the recovery mechanism, as a slightly general version of the time-independent theory with the kinematic hardening rule. In the discussion of the time-independent limit, the duration of time required for the inelastic strain to reach its saturated value is defined.

43273 (LBL—7397) **Development of nickel-free austenitic stainless steels for ambient and cryogenic applications.** Haddick, G.T.; Thompson, L.D.; Parker, E.R.; Zackay, V.F. (California Univ., Berkeley (USA)). Feb 1978. Contract W-7405-ENG-48. 33p. (CONF-7709115—1). Dep. NTIS, MF A01.

From Conference on materials substitution) availability, energy and environmental factors; Chicago, IL, USA (27 Sep 1977).

Portions of document are illegible.

A series of alloys have been developed as possible replacements for some austenitic stainless steels. These alloys utilized a Mn substitution for Ni and a reduced Cr concentration from the 18% ordinarily found in the AISI 300 series stainless steels to a concentration of 13%. The base system studied was an alloy containing Fe-16%Mn-13%Cr while other elements added included small additions of N, Si and Mo. A range of microstructures was produced from the alloying additions. The base composition had a triplex (fcc, hcp, bcc) structure while the most highly modified compositions were fully austenitic. Mechanical testing included tensile testing and Charpy V-notch testing conducted at various temperatures between -196°C to 23°C. Excellent combinations of strength and ductility were obtained (40—65 ksi yield strength, 100—125 ksi ultimate strength, 45—75% elongation and 60—80% reduction of area) at room temperature. Upper shelf energies in Charpy V-notch testing were as high as 185 ft-lbs with a ductile-brittle transition temperature (DBTT) of -160°C. Analysis of fracture surfaces determined that alloys without interstitials had no transition in the mode of failure between room temperature and liquid nitrogen temperature. Results of an ASTM sensitization corrosion test, where the experimental alloys were compared to 347 stainless steel, indicated that the alloys were not susceptible to intergranular attack.

43274 (N—78-11081) **Cost benefit study of advanced materials technology for aircraft turbine engines.** Hillery, R.V.; Johnston, R.P. (General Dynamics/Astronautics, San Diego, Calif. (USA). Space Science Lab.). Sep 1977. Contract NAS3-20074. 89p. (NASA-CR—135235). NTIS PC A05/MF A01.

The cost/benefits of eight advanced materials technologies were evaluated for two aircraft missions. The overall study was based on a time frame of commercial engine use of the advanced material technologies by 1985. The material technologies evaluated were eutectic turbine blades, titanium aluminide components, ceramic vanes, shrouds and combustor liners, tungsten composite FeCrAlY blades, gamma prime oxide dispersion strengthened (ODS) alloy blades, and no coat ODS alloy combustor liners. They were evaluated in two conventional takeoff and landing missions, one transcontinental and one intercontinental.

43275 (N—78-11232) **Manufacture and engine test of advanced oxide dispersion strengthened alloy turbine vanes. Final report.** Bailey, P.G. (General Electric Co., Cincinnati, Ohio (USA). Material and Process Technology Labs.). Oct 1977. Contract NAS3-18915. 158p. (NASA-CR—135269; R—77AEG569). NTIS PC A08/MF A01.

Oxide-Dispersion-strengthened (ODS) Ni—Cr—Al alloy systems were exploited for turbine engine vanes which would be used for the space shuttle thermal protection system. Available commercial and developmental advanced ODS alloys were evaluated, and three were selected based on established vane property goals and manufacturing criteria. The selected alloys were evaluated in an engine test. Candidate alloys were screened by strength, thermal fatigue resistance, oxidation and sulfidation resistance. The Ni—16Cr-(3 to 5)Al—ThO_2 system was identified as having attractive high temperature oxidation resistance. Subsequent work also indicated exceptional sulfidation resistance for these alloys.

43276 (N—78-11243) **Effect of simulated service conditions on stainless steel type 316.** Kent, J.C.W.; Infield, J.A. (Bristol Univ. (UK). Dept. of Mechanical Engineering). Jun 1977. 52p. (BU—77/B.4). NTIS PC A04/MF A01.

Materials used in high temperature applications are often subject to a departure from their virgin properties due to severe service conditions. It is therefore necessary to investigate the changes in the microstructure and mechanical properties of materials used in such applications in order to avoid premature and costly failure. The project was devised in order to determine the effect of prior damage and aging on stainless steel type 316 which is used in the construction of the fast breeder nuclear reactor. This was accomplished by subjecting prestrained, fatigued, and cold worked specimens to an accelerated aging process and observing subsequent changes in the tensile, hardness, creep, and impact properties of the material. The results obtained showed that for annealed material, irrespective of damage, the tensile strength increased with aging time after an initial period of weakening. Prior fatigue and prior strain were observed to accelerate these effects. Cold worked material tended to deteriorate continuously with aging, while the impact and hardness properties of all pretreated types of alloy decreased with aging.

43277 (SAND—77-0199C) **Technique for measurements of plane waves of uniaxial strain.** Graham, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 72p. (CONF-770397—1). Dep. NTIS, PC A04/MF A01.

From Nonlinear waves in solids workshop; Chicago, IL, USA (21 Mar 1977).

The measurement of plane waves in uniaxial strain, in which large surface areas are loaded and the measurements are restricted to a central region that is not influenced by lateral boundaries, is discussed. Measuring techniques are covered and instruments are discussed. (GHT)

43278 (SAND—78-0181C) **Physically-based internal variable model for rate-dependent plasticity.** Krieg, R.D.; Swearengen, J.C.; Rohde, R.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 14p. (CONF-780609—3). Dep. NTIS, PC A02/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

A unified model is developed for creep and plasticity in metals, using internal state variables to reflect the current microstructure. The inelastic flow rule is taken to be a power function incorporating a kinematic and an isotropic internal variable, where the microstructural origins of these properties are dislocation pileups and dislocation obstacle interaction, respectively. The model is generalized for three-dimensional deformation and evolutionary functions are developed for the internal variables to account for strain hardening and thermal recovery. An experimental test and data reduction procedure is presented which allows all the material constants to be determined for materials which exhibit secondary creep. The procedure is applied to pure aluminum. This generalized model provides a physical basis for predicting mechanical response along arbitrary deformation paths.

43279 (TREE—1254) **Status report of physical and mechanical test data of Alloy 718.** Korth, G.E.; Smolik, G.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1978. Contract EY-76-C-07-1570. 92p. Dep. NTIS, PC A05/MF A01.

Interim results of Alloy 718 physical and mechanical properties testing are reported. All tests were performed on material given the 954°C solution anneal and 718/621°C duplex age. Tests were conducted in air and included determinations of electrical resistivity, thermal conductivity, thermopower, differential thermal expansion, mean thermal expansion, Young's modulus, shear modulus, Poisson's ratio, tensile properties, creep-rupture properties, low-cycle and high-cycle fatigue properties, notch effects on fatigue behavior, creep-fatigue interaction, cyclic stress-strain and Charpy impact behavior. All properties were measured from 24 to 760°C except for fatigue; fatigue tests were conducted from 24 to 649°C.

43280 Effect of minor elements of hot-cracking tendencies of Inconel 600. Savage, W.F.; Nippes, E.F.; Goodwin, G.M. (Oak Ridge National Lab., TN). *Weld. J. (Miami);* **56**: 245S-253S(Aug 1977).

An investigation was undertaken to determine the effect of six minor elements, S, P, Si, Mn, Ti and Al, on the hot-cracking propensity of Inconel, a solid-solution strengthened nickel-base alloy. In order to determine the effects of these six elements, a new weldability evaluation test, the "Tigamajig" test, was developed. An outgrowth of the "Varestraint" test, the Tigamajig test combines the advantages of its predecessor with a reduced specimen size and ease of specimen preparation. A technique was used which allowed the preparation of a large number of specimens of systematically varied composition by the incorporation of compacted-and-sintered powder inserts containing the desired minor-element additions.

43281 Product form variability in the mechanical behavior of Type 304 stainless steel at room temperature and 593°C (1100°F). Swindeman, R.W.; McAfee, W.J.; Sikka, V.K. (Oak Ridge National Lab., TN). pp 41-64 of Reproducibility and accuracy of mechanical tests. Philadelphia; American Society for Testing and Materials (1977).

Data are presented that describe the variability of 15 products of a reference heat of Type 304 stainless steel tested in the laboratory reannealed condition. Included in the data are chemistry, hardness, grain size, yield strength at room temperature, tensile curves at 593°C (1100°F), and creep-rupture curves to 1000 h at 593°C (1100°F). The standard deviation, representing the variation in the yield strength of the 15 products about the average, is near +-7.7 MPa at room temperature and +-6.3 MPa at 593°C (1100°F). The 1000-h rupture strength varies by 3.8 percent from the average and the stress to produce a minimum creep rate of 0.01 percent/h by 3.0 percent. Variation of strength in the primary creep range is also examined. The strength for a standard product, 25-mm plate, for which a large data base exists, is compared to the behavior of the other products, and it is observed that the 25-mm plate is fairly representative of the product average. Reasons for variability are examined, and it is thought that carbon content, nitrogen content, grain size, temperature control, and extensometer performance contribute to variability, and the extent depends on the type of test.

43282 Effect of copper, tin, nickel, and chromium on mechanical properties of low-carbon steel. Owen, C.V.; Schmidt, F.A.; Carlson, O.N. (Ames Labs., IA). *Met. Technol.;* 441-445(Oct 1976).

The effects of those impurities most commonly found in scrap steel on the mechanical properties of low-carbon steel were investigated. The yield and tensile strengths, uniform elongation, strain-hardening exponent, and normal anisotropy ratio were determined as a function of copper, nickel, tin, and chromium content. Attempts to correlate the formability of steel sheet with changes in these properties are described. Emphasis is placed on the use of the normal anisotropy ratio and the strain-hardening exponent for predicting total formability performance. The results of these tests indicate that tin is most detrimental to the formability of mild steel and that appreciable amounts of copper, nickel, and chromium can be tolerated with relatively few adverse effects.

43283 Precipitation of TiC in thermally embrittled maraging steels. Nes, E. (Central Inst. for Industrial Research, Blindern-Oslo); Thomas, G. *Metall. Trans., A;* 7: 967-975(Jul 1976).

It is shown that maraging steels can be embrittled by the precipitation of TiC during slow cooling and/or intermediate annealing in the austenite temperature range. An important aspect in this embrittlement is the occurrence of lamellar precipitation of TiC at the austenite grain boundaries, generating a cellular structure of large fern leaf-like carbides. Within the austenite grains a nonuniform distribution of irregularly plate-shaped TiC particles are formed with (100) austenite habit orientation. Quenching to martensite, prior to any intermediate anneals, changes the carbide distribution upon subsequent annealing treatments into a fine dispersion of TiC particles. The embrittlement resulting from the various isothermal annealing treatments in the austenite temperature region could all be directly related to the carbide distribution in the prior austenite grain boundary region.

43284 Evaluation of toughness in AISI 4340 alloy steel austenitized at low and high temperatures. Ritchie, R.O. (Univ. of California, Berkeley); Francis, B.; Server, W.L. *Metall. Trans., A;* 7: 831-838(Jun 1976).

It has been reported for as-quenched AISI 4340 steel that high temperature austenitizing treatments at 1200°C, instead of conventional heat-treatment at 870°C, result in a two-fold increase in fracture toughness, K/sub Ic/, but a decrease in Charpy impact energy. This paper seeks to find an explanation for this discrepancy in Charpy and fracture toughness data in terms of the difference between K/sub Ic/ and impact tests. It is shown that the observed behavior is independent of shear lip energy and strain rate effects, but can be rationalized in terms of the differing response of the structure produced by each austenitizing treatment to the influence of notch root radius on toughness. The microstructural factors which affect this behavior are discussed. Based on these and other observations, it is considered that the use of high temperature austenitizing be questioned as a practical heat-treatment procedure for ultrahigh strength, low alloy steels. Finally, it is suggested that evaluation of material toughness should not be based solely on K/sub Ic/ or Charpy impact energy values alone; both sharp crack fracture toughness and rounded notch impact energy tests are required.

43285 Role of dislocations and interstitial solutes on the strength of ferrous martensite. Kelly, P.M.; Kehoe, M. (AAEC Research Establishment, Lucas Heights, Australia). pp 399-404 of Proceedings of the first JIM international symposium on "new aspects of martensitic transformation". Sendai, Japan; Japan Inst. of Metals (1976).

From 1. JIM international symposium on "new aspects of martensitic transformation"; Kobe, Japan (10 May 1976).

The established relationship between the strength of lath martensite and the square root of the carbon content is shown to be NOT due to interstitial solid solution hardening. Instead, the strength is related to a carbon-dependent dislocation density. In the case of ferrite with large amounts of carbon in solution (up to 0.04 wt.%), there is some evidence for true solid solution hardening.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 42395, 43259, 43262, 43279, 43320, 44010

43286 (AD-A—046920) **High power magnetostrictive transducer rare earth—iron materials. Technical report 1976—1977.** Callen, E. (American Univ., Washington, D.C. Dept. of Physics). Oct 1977. Contract N00014-75-C-0736. 10p. NTIS PC A02/MF A01.

This report covers various phenomena and related studies on the magnetostrictive properties of rare earth and iron alloys and their application toward the fabrication of a high-power magnetostrictive transducer.

43287 (COO—3551-44) **Thermodynamic and transport properties of interstitial hydrogen isotopes in metal systems. Final report.** Brown, J.S. (Vermont Univ., Burlington (USA)). 1978. Contract EY-76-S-02-3551. 19p. Dep. NTIS, PC A02/MF A01.

The results of work under this contract from its inception under AEC in 1969 to its conclusion under ERDA in 1978 are discussed. The initial objectives of this research and how these objectives have changed over the Contract period are presented. All papers and conference talks which relate to the Contract from 1969 through 1978 are listed. Current endeavors under the contract are summarized and the present status of the published literature is surveyed. In addition, a number of problems that are still unresolved are identified; and some directions that future research might take on the electronic and transport properties of PdH and PdD and liquid transition metals are indicated.

43288 (ORNL—5313) **Study of the eggects of several variables on the thermal conductivity of 2 1/4 Cr—1 Mo steel.** Williams, R.K.;

Graves, R.S.; Moore, J.P. (Oak Ridge National Lab., Tenn. (USA)). Apr 1978. Contract W-7405-ENG-26. 74p. AT.

The thermal and electrical conductivities of nine commercial heats of 2¼ Cr-1 Mo heat exchanger steel were determined near room temperature. The results indicate a +- 4.4 percent heat-to-heat variation of the thermal conductivity of annealed samples. Data obtained on three of the heats showed that the heat-to-heat variation decreased to +-3.1 percent at 1000 K. All of the results show that the ASME Code values for this alloy are too low. Supplementary room-temperature data on aged samples show that the thermal conductivity will not change much during long-term service in the 700 to 800 K range. Analysis of the electrical and thermal conductivity data shows that the results are consistent with the well-established property-temperature variation for pure iron. Attempts to quantitatively relate property variations to chemical and microstructural differences met with only limited success.

43289 (UCRL—50016-77-4, pp 26-34) **Determination of sound velocity across the diameter of a liquid metal column.** 31 Dec 1977.

In Mechanical Engineering Department quarterly report, October—December 1977.

A noncontact method using laser energy deposition and displacement interferometry for the measurement of sonic velocity in liquid metals is described. The method yields information not obtainable by conventional techniques. (GHT)

43290 **Positron annihilation studies of quenched aluminium.** Wampler, W.R.; Gauster, W.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). *J. Phys., F (London);* **8**: No. 1, L1-L5(Jan 1978).

Positron annihilation Doppler broadening measurements were made on quenched aluminium single-crystal and polycrystal samples as a function of isochronal annealing. Changes in the annihilation lineshape due to clustering of vacancies were observed. The measurements show that clusters begin to form very early in stage III and that the degree of clustering depends strongly on the density of vacancy sinks in the samples.

43291 **Evaluation of sodium incipient superheat measurements with regard to the importance of various experimental and physical parameters.** Kottowski, H.M.; Savatteri, C. (European Atomic Energy Community, Ispra (Italy)). *Int. J. Heat Mass Transfer;* **20**: No. 12, 1281-1300(Dec 1977).

Published results on the parameters which influence superheat are not definite. Experimental evidence on the effect of some parameters has been inconsistent and conflicting. The most consistent agreement is seen in the influence of oxide impurity and gas entrainment. In both cases superheat decreases with increasing gas entrainment and oxide level. The most inconsistent and conflicting experimental evidence concerns the effect of heat flux and of temperature ramp. The data of bulk superheat as far as the trend is concerned are in good agreement. The bulk superheat definitely decreases with increasing velocity. The influence of the heating wall material on the superheat is uncertain. Experiments on materials compatible with sodium did not exhibit significant effects. Most of the experiments in which the influence of the operation time has been observed were short time tests. It is supposed that the effect of operating conditions was masked by the degassing of the heating surface during heating up or boiling. There is experimental evidence that for given test conditions a characteristic threshold superheat range is not exceeded. The threshold superheat level is presumably determined by the heating surface finishing, the oxide level and the gas loading of the sodium. A general evaluation of the results of the loop experiment shows an average value of superheat for technically clean sodium of 80 +- 300C (0_2-impurity of about 5 to 10 ppm) and for sodium with impurity of about 40 ppm of about 25 +- 20^0C.

43292 **Theoretical study of the site dependence of the surface vibrational frequencies of H adsorbed on a Be surface.** Bagus, P.S. (IBM Research Laboratory, San Jose, Calif., USA); Bauschlicher, C.W. Jr. (California Univ., Berkeley (USA)). pp 989-991 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Volume 2. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna, Austria; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

The interaction of H with the (0001) surface of Be has been studied using clusters of Be atoms chosen to simulate the substrate. The H atom has been placed at four different adsorption sites. Ab initio Hartree-Fock calculations are performed to obtain the interaction energies at various vertical distances of H from the surface. Vibrational energies are obtained from these Hartree-Fock results. The vibrational energies are substantially different for different surface coordinations of the adsorption sites. Force constants have been obtained from a simple model which connects the H with springs to the nearest substrate atoms. However, the spring constants for different sites are not equal but rather the sums of the force constants are equal.

43293 **Grain boundary precipitation in a nickel-beryllium alloy.** Nordstrom, T.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). pp 235-244 of Microstructural science. Volume 5. Proceedings of the ninth annual technical meeting of the International Metallographic Society. Braun, J.D.; Arrowsmith, H.W.; McCall, J.L. (eds.). Amsterdam, Netherlands; Elsevier (1977).

From 9. Annual International Metallographic Society meeting; Seattle, WA, USA (25 Jul 1976).

The morphology and kinetics of discontinuous grain boundary precipitation has been studied in a nickel 1.89 wt% (11.1 at.%) beryllium alloy. The cells were found to have an irregular lamellar structure with a continuous nickel rich phase and NiBe platelets. There is no consistent habit plane observed but at least three orientation relationships do exist between the two phases. The kinetics of the reaction were found to follow a linear growth with time. The activation energy of approximately 55 kcal/mole is less than bulk self diffusion of nickel but greater than grain boundary self diffusion.

43294 **Magnetic field induced conduction electron polarization, magnetization density, and neutron magnetic form factor of Pt metal.** Watson-Yang, T.J.; Freeman, A.J. (Northwestern Univ., Evanston, Ill. (USA)); Koelling, D.D. (Argonne National Lab., Ill. (USA)). *J. Magn. Magn. Mater.;* **5**: No. 4, 277-286(1977).

Results are presented of a detailed relativistic augmented plane wave (RAPW) study of the magnetic field induced conduction electron polarization, magnetization density, and neutron magnetic form factor of Pt metal. It is found that the spherical part of the total induced spin density is very localized spatially and almost entirely d-like in character, with the band 6 contribution differing substantially from its counterpart in Pd metal. The spin only estimate of the Weiss-Freeman asymmetry parameter is large (93% tsub(2g) and 7% esub(g)). The predicted Fermi surface dimensions for both the electron and hole surfaces (and the suitably enhanced effective masses) show excellent agreement with the recent measurements of Dye et al.

43295 **de Haas—van Alphen measurements and phase shift analysis of electronic scattering anisotropy in solid solutions of Ga in Au.** Dye, D.H. (Northwestern Univ., Evanston, IL); Ketterson, J.B.; Lowndes, D.H.; Crabtree, G.W.; Windmiller, L.R. *J. Low Temp. Phys.;* **26**: No. 5/6, 945-951(1977).

Measurements of the electronic scattering anisotropy due to dilute concentrations of gallium in gold have been carried out using the de Haas-van Alphen effect. These measurements have been analyzed using the partial wave approach, and the results have been compared with those for other noble metal-heterovalent impurity systems. Gallium, which has a valence difference of 2 with respect to gold, exhibits a much smaller change in lattice constant upon alloying than any of the other noble metal-heterovalent impurity systems studied to date. The results reported here indicate that the Friedel phase shifts for solid solutions of Ga in Au are considerably different from those for the other systems, in which impurity-induced strain is expected to play a larger role. The phase shifts for solid solutions of Ga indicate that the Coulomb potential is effectively screened within a relatively short distance from the impurity site.

43296 **Creep of polycrystalline alumina, pure and doped with transition metal impurities.** Lessing, P.A.; Gordon, R.S. (Univ. of Utah, Salt Lake City). *J. Mater. Sci.;* **12**: 2291-2302(1977).

Grain size effects were used to evaluate the relative contributions of aluminium lattice and oxygen grain boundary diffusion to the high temperature (1350 to 1550°C) steady state creep of polycrystalline alumina, pure and doped with transition metal impurities (Cr, Fe). Divalent iron in solid solution was found to enhance both aluminium lattice and oxygen grain-boundary diffusion. Large concentrations of divalent iron led to viscous Coble creep which was rate-limited entirely by oxygen grain-boundary diffusion. Nabarro-Herring creep which was rate-limited by aluminium lattice diffusion was observed in pure and chromium-doped material. Chromium additions had no effect on diffusional creep rates but significantly depressed non-viscous creep modes of deformation. Creep deformation maps were constructed at various iron dopant concentrations to illustrate the relative contributions of aluminum grain boundary, aluminium lattice, and oxygen grain-boundary diffusion to the diffusional creep of polycrystalline alumina.

43297 **Low temperature specific heat of glasses and amorphous solids.** Couchman, P.R. (Univ. of Massachusetts, Amherst); Reynolds, C.L. Jr.; Cotterill, R.M.J. *Nature (London);* **264**: No. 5586, 534-535(9 Dec 1976).

In a previous paper, the anomalous low temperature thermal properties of amorphous materials were attributed to the inherent nature of the amorphous state, conceived of as the crystalline state saturated with the most favoured dislocations. Using Granato's vi-

brating string model of a dislocation, an estimate of the excess specific heat of $Pd_{0.775}$ $Cu_{0.06}$ $Si_{0.165}$ was provided. Several points in the earlier paper are clarified.

43298 Internal hydrogen supersaturation produced by dislocation transport. Johnson, H.H. (Cornell Univ., Ithaca, NY); Hirth, J.P. *Metall. Trans., A;* 7: 1543-1548(Oct 1976).

A quantitative model is presented for the generation of internal supersaturations of hydrogen by kinetic rather than thermodynamic means. The maximum brittleness and slow strain rate limit is treated. The process invoked assumes hydrogen transport to deposition sites by dislocation drag, and reemission of the hydrogen by diffusion. The kinetic supersaturation is calculated from a balance between hydrogen arrival and departure rates, for internal and external hydrogen sources, and for smooth section and crack geometries. When applied to ferritic and austenitic steels, the model predicts that the kinetic supersaturations are extremely small in all realistic situations.

43299 Mechanism of the shape memory effect in Ni—Ti alloy. Mohamed, H.A.; Washburn, J. (Lawrence Berkeley Lab., CA). *Metall. Trans., A;* 7: 1041-1043(Jul 1976).

Several alloys have been known to exhibit a mechanical shape memory effect associated with a thermoelastic martensitic-type phase transformation. Of particular interest is the alloy NiTi near the equiatomic composition. Experimental results are presented on the deformation modes in the early stages of 55.4 wt percent Ni (50.3 at. percent) alloy in a partially transformed state. Wires from this same batch of material have been put through more than 10^7 cycles of shape recovery in a new type of heat engine.

43300 Numerical investigation of spin waves in ferromagnetic iron. Cooke, J.F.; Lynn, J.W.; Davis, H.L. (Oak Ridge National Lab., TN). *Solid State Commun.;* **20**: 799-801(1976).

Spin wave energies and intensities have been calculated along three principal symmetry directions for ferromagnetic iron. These calculations are based on an itinerant model which incorporates band and wave-vector dependence of the relevant Coulomb matrix elements. The results indicate that iron's spin waves can be described completely by an itinerant model without recourse to additional assumptions about strong Hund's rule coupling or local moment behavior.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 42142, 42145, 42212, 43275, 43388

43301 (AD-A—047652) **Sulfur in the corrosion of superalloys. Final report 1 Apr 74—30 Jun 77.** Wagner, J.B. Jr. (Northwestern Univ., Evanston, Ill. (USA)). Nov 1977. 9p. NTIS PC A02/MF A01.

Radiotracer sulfur-35 has been diffused into single crystals of nickel oxide as a function of oxygen pressure, doping additions of lithium or chromium and temperature (1000 to 1250 C). The measured data were found to deviate markedly from the error function complement dependence for diffusion from a constant source. The deviation is attributed to the migration of sulfur by the 'double mode simultaneous diffusion mechanism.' The faster mode is suggested to be via nickel vacancies and the slower mode via oxygen vacancies. The diffusivities are D(fast) = 2.94 exp (-86.6 kcal/RT) and D(slow) = 1.08×10^{-9} exp(-32.8 kcal /RT). These data show that sulfur migrates through nickel oxide by two different mechanisms at two different rates. A concurrent study was performed on the SO_2-O_2 corrosion of Ni and Ni-2 1/4% Cr alloy between 900 and 1050 C. Constant oxygen pressure (20%) was used and 0, 2, 5 and 10% SO_2 with the balance argon. The rates of corrosion increased as the percent SO2 increased, attaining an apparent maximum between 5 and 10%. No sulfides were found at the nickel-nickel oxide interface.

43302 (AD-A—047957) **Hydrogen embrittlement of niobium III: high-temperature behavior. Technical report.** Gahr, S.; Birnbaum, H.K. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). 18 Oct 1977. Contract N00014-75-C-1012. 32p. NTIS PC A03/MF A01.

The deformation behavior in niobium-hydrogen alloys was investigated in the temperature range 125—500 C and at compositions up to H/Nb of 0.9. High temperature tensile tests and fractographic studies were applied to determine the fracture mechanisms. It is shown that at T < or = 450 C and H/Nb > or = 0.3 fracture occurs by a cleavage mode. The mechanism of this high temperature hydrogen embrittlement is discussed. The fracture mechanism is shown to be consistent with the stress induced formation and cleavage of NbH_2.

43303 (AD-A—047963) **On the oxidation of niobium in 'pure' hydrogen atmospheres. Technical report.** Makenas, B.J. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). 18 Oct 1977. Contract N00014-75-C-1012. 16p. NTIS PC A02/MF A01.

The oxidation of niobium at very low partial pressures of oxygen was studied using transmission electron microscopy and electron diffraction. The oxidation was carried out in 'high purity' hydrogen atmospheres.

43304 (AD-A—048059) **Accelerated laboratory corrosion test for materials and finishes used in naval aircraft. Progress report.** Ketcham, S.J. (Naval Air Development Center, Warminster, Pa. (USA). Air Vehicle Technology Dept.). 14 Sep 1977. 11p. (NADC—77252-30). NTIS PC A02/MF A01.

An accelerated laboratory corrosion test has been developed to screen materials and finishes for use on naval aircraft. Sulfur dioxide is introduced at periodic intervals into a conventional salt fog chamber to simulate conditions produced by the carrier stack gas/marine environment. Procedures for conducting the test are described.

43305 (N—77-32306) **Hydrogen absorption of freshly-generated titanium surfaces.** Raetzer-Scheibe, H.J.; Spriestersbach, U.; Buhl, H.; Stoeppler, M. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 6 Apr 1977. 24p. (DLR-FB—77-14). NTIS PC A02/MF A01.

The tritium absorption of active titanium interfaces in aqueous NaCl solutions under potentiostatic conditions should give information about the hydrogen absorption of the titanium alloy Ti6A14V. Especially the comparison of the known stress corrosion cracking (SCC) resistance as function of the electrode potential and correspondingly of the tritium content in the material, should point out the importance of hydrogen for the SCC mechanism. The results show that the potential has influence on the tritium content in the range +1600 to -1400 mV (sat. Ag/AgCl). However, in this range the SCC-susceptibility is strongly dependent on the potential. This means that hydrogen is not so important for SCC as assumed up to now.

43306 (NTIS/PS—77/1179) **Stress corrosion of steel (a bibliography with abstracts). Report for 1964—77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 244p. NTIS PC N01/MF N01.

The citations cover crack propagation, fracture, tests, surface finishing, working, coatings, deformation, and fatigue in relation to stress corrosion. The majority of studies in this report are on nuclear reactor, aircraft, and spacecraft materials. Stainless steel stress corrosion is excluded. (This updated bibliography contains 239 abstracts, 70 of which are new entries to the previous edition.)

43307 (NTIS/PS—77/1186) **Stress corrosion of stainless steels (citations from the NTIS data base). Report for 1964—77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 292p. NTIS PC N01/MF N01.

This compilation covers research on deformation, cracking, electrochemistry, additives, kinetics, test methods and solutions in relation to stress corrosion. A majority of the research concerns nuclear reactor materials and spacecraft components. Citations of mechanical property and compatibility data in relation to stress corrosion are included. Design criteria and corrosion resistance is also discussed. (This updated bibliography contains 287 abstracts, 52 of which are new entries to the previous edition.)

43308 (SAND—78-0524C) **Environmentally stable sputter-deposited thin films.** Sharp, D.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 17p. (CONF-780536—1). Dep. NTIS, PC A02/MF A01.

From Varian semiconductor processing seminar; Palo Alto, CA, USA (2 May 1978).

Accelerated corrosion data are presented for the titanium-silver and chrome-gold thin film metallization systems presently used at Sandia Laboratories. Improvements in corrosion, hence reliability, as a result of interposing a thin intermediate layer of either platinum or palladium are shown. Potentiometric measurements showing the alteration of corrosion potential with the use of palladium for the titanium-silver system are also presented.

43309 (SAND—78-0530) **Fatigue of steel in simulated drilling environments.** Eckelmeyer, K.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 17p. Dep. NTIS, PC A02/MF A01.

The current guidelines for selection of steel for use as drill stem in H_2S-containing environments are based on data obtained in static load tests. In actual use, however, drill stem is frequently subjected to cyclic, or fatigue, loading. This study shows that fatigue loading in a standard H_2S-containing testing environment causes crack growth to occur at stress intensities far below the static load threshold. It also shows that material performance rankings based on static load tests are not necessarily meaningful for the more severe case of fatigue loading. It is concluded that the current guidelines could be improved by giving additional consideration to the performances of materials under fatigue loading conditions.

43310 (UCRL—50016-77-4, pp 2-8) **Materials compatibility study of 316 stainless steel at the LLL Tritium Facility.** 31 Dec 1977.

In Mechanical Engineering Department quarterly report, October—December 1977.

A test series to investigate the stress corrosion rate of nuclear grade 316 VIM/VAR stainless steel is described.

43311 (WARD-NA—3045-51) **Tribological and corrosion behavior of materials for high temperature sodium service.** Ray, W.E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1978. Contract EY-76-C02-3045-001. 19p. AT.

The behavior of two nickel base alloys, Inconel 718 and Tribaloy 700 under prototypic, out of reactor, sodium conditions is described. Results are presented on the variation of friction coefficients with rubbing distance, sodium temperature (232 to 627°C), and dwell time in contact; and overall wear coefficients are compared. Corrosion data obtained from sodium loop testing are reported for both materials after long term studies. The extensive metallographic evaluation which was conducted to determine the mode and extent of the wear and corrosion processes for both materials in sodium is described. Generally speaking, the Tribaloy 700 material exhibits superior tribological and corrosion behavior to that of the Inconel 718 alloy in high temperature sodium testing.

43312 **Aluminium corrosion studies. III. Chloride adsorption isotherms on corroding aluminium.** Berzins, A.; Lowson, R.T.; Mirams, K.J. (A.A.E.C. Research Establishment, Sutherland, Australia). *Aust. J. Chem.;* **30**: 1891-1903(1977).

The adsorption isotherms for chloride on a corroding aluminium surface have been measured by using ^{36}Cl as a radioactive tracer. The amount of chloride adsorbed, w/sub Cl/, was a function of chloride concentration, [Cl], and time, t, according to: log w/sub Cl/ = 0.64(log[Cl] + log t) — 7.8, where w/sub Cl/ is expressed as g cm^{-2}, [Cl] as mol l^{-1} and t as minutes. Superimposed on the general curve was a fine structure which correlated with the stages of development of a corroding aluminium surface. The adsorption was localized to corroding pit sites. Addition of nitrate or sulphate delayed but did not prevent the uptake of chloride; the hydroxide ion was considered to have a similar effect. It was concluded that a corroding aluminium surface has a variety of adsorption sites with different adsorption properties; only a minority of these sites are potential or active sites for pitting corrosion.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 44009

43313 (AD-A—047406) **Cooperative radiation effects simulation program. Semiannual progress report 1 Sep 76—28 Feb 77.** Steele; Beach, L.A. (Naval Research Lab., Washington, D.C. (USA)). Sep 1977. 88p. (NRL-MR—3588). NTIS PC A05/MF A01.

The Cooperative Radiation Effects Simulation Program (CORES) is a collaborative effort of the Engineering Materials and Radiation Technology Divisions of NRL materials and General Sciences Area. The goal of the research is to provide the theoretical and experimental bases for understanding the mechanisms of nuclear radiation damage of metals, as well as a theoretical insight into energy deposition processes. In this the van de Graaff and cyclotron are used to simulate rapidly the radiation damage produced over long periods in reactor neutron environments. Progress for this period includes the following: (1) the effect of focus on void and bubble size measurement by electron microscopy; (2) ultra-high-vacuum target furnace for heavy-ion irradiations; (3) a comparison of the swelling produced in nickel by neutron irradiation and by ion bombardment; (4) profiling light element concentrations by nuclear techniques; (5) transient ion-simulated irradiation-induced creep of nickel; and (6) displacement damage calculation procedures.

43314 (AD-A—047410) **Swelling and alloy stability of potential fast-breeder-reactor structural alloys irradiated in NRL experiment h-5. Interim report.** Reed, J.R.; Smidt, F.A. Jr. (Naval Research Lab., Washington, D.C. (USA)). 15 Sep 1977. Contract AT(49-5)-2110. 24p. (NRL—8130). NTIS PC A02/MF A01.

Seven commercial alloys of potential interest for fast-breeder-reactor structural alloys have been irradiated in the EBR-II to a fluence of 1.6 X 10^{22} n/sq cm, E>0.1 MeV, at 455 C (850 F) and subsequently examined and analyzed using transmission electron microscopy. Irradiated were Inconel 718, Incoloy 800, Inconel 600, Inconel 625, PE-16, Sandvik 12R72HV, and Inconel 744. The experiment was designed to examine the alloy stability during irradiation and to measure swelling resistance. Inconel 718 and PE-16 exhibited the best swelling. resistance, and Sandvik 12R72HV and Incoloy 800 had the poorest resistance to swelling. Inconel 744, an experimental superplastic alloy with a duplex microstructure, exhibited one of the highest swelling rates known for the austenite phase but showed no swelling for the ferrite phase. Inconel 625, Inconel 600, and Incoloy 800 showed extensive precipitation of phases not present prior to irradiation.

43315 (GA-A—14608) **Temperature dependence of hydrogen sputtering of carbon coatings on platinum.** Smith, J.N. Jr.; Meyer, C.H. Jr. (General Atomic Co., San Diego, Calif. (USA)). Oct 1977. Contract EY-76-C-03-0167-038. 20p. (CONF-780431—3). Dep. NTIS, PC A02/MF A01.

From 3. conference on plasma interaction in controlled fusion devices; Abingdon, Oxfordshire, UK (3 Apr 1978).

H_2^+ sputtering of thin (400 to 600 A) films of C deposited on Pt is measured over the range from 20 to 850°C at an ion energy of 5 keV. The sputter yield varies from 2 x 10^{-2} atoms/ion at room temperature to a maximum value of 10^{-1} atoms/ion at 530°C. This result is compared with several previous measurements that employed bulk C targets. The differences observed are attributed largely to the effect of different experimental ion dose rates. Thus, as the dose rate increases, the maximum value of the yield decreases and the temperature at which this maximum occurs increases. This behavior is described by the model of CH_4 production developed by Erents et al. The relation of these results to first wall coatings in fusion energy devices is discussed.

43316 (HEDL-TME—78-17) **Statistical analysis of low cycle fatigue data on irradiated breeder reactor structural materials.** Menon, M.N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1978. Contract EY-76-C-14-2170. 58p. Dep. NTIS, PC A04/MF A01.

This report compiles the available data produced in the United States on the fatigue behavior of irradiated annealed 304 SS, 316 SS, 304L SS and Incoloy 800 and 11 percent cold worked 304 SS and 316 SS, and the results of a statistical analysis describing the cyclic life as a function of the principal test variables. The method used to analyze the data was a stepwise multiple linear regression procedure. The regression curves describe the experimental data quite well. Because of the limited data base, extrapolation of the curves beyond the data base is not generally recommended. However, the present investigation does point to the usefulness of stepwise multiple regression as a valid tool to analyze fatigue data.

43317 (PNL—2495) **Dual-beam, charged-particle irradiation facility for simulation of nuclear environment.** Kissinger, H.E.; Brimhall, J.L.; Simonen, E.P.; Charlot, L.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1978. Contract EY-76-C-06-1830. 34p. Dep. NTIS, PC A03/MF A01.

Heavy-ion bombardment provides a method for simulating neutron damage to metals and other materials. Simultaneous implantation of He^+ ions allows the study of effects of neutronically generated helium in these samples. A 2-MeV Van de Graaff and a 2-MeV tandem accelerator at Battelle, Pacific Northwest Laboratories (PNL) have been combined to provide dual-beam irradiation with heavy ions, Ni^{++} or Ta^{++}, and with He^+ ions. This irradiation facility allows independent control of beam currents and energies for both heavy-ion and helium-ion beams, as well as sample temperatures to 1200°C. It will be used both for investigation of materials for advanced reactor applications and for basic studies of radiation damage mechanisms. Preliminary results on molybdenum irradiated to two dose levels at 1000°C, with and without simultaneous helium implantation, show the effect of helium on void nucleation. When helium is continuously implanted, the number of voids increases with dose. Without helium, existing voids grow in size but the number is unchanged. At higher heavy-ion dose rates, this effect of helium is less pronounced.

43318 (N—78-11968) **Gamma-ray testing technique for spacecraft.** Gribov, B.S.; Repin, N.N.; Sakovich, V.A.; Sakharov, V.M. Translated from *Kosm. Issled.;* **15**: No. 3, 491-493(1977). 7p. (NASA-TM—75053). NTIS PC A02/MF A01.

The simulated cosmic radiation effect on a spacecraft structure is evaluated by gamma ray testing in relation to structural thickness. A drawing of the test set-up is provided and measurement errors are discussed.

43319 **Electron-microscopy study of neutron-induced defect clusters in niobium.** Chang, C.P.; Chen, C.W. (Ames Lab., Iowa (USA)). *Cryst. Lattice Defects;* 7: No. 2, 91-105(1977).

Moderately pure niobium was irradiated to the fluence of 8 x 10^{19} neutrons (E > 0.1 MeV) per cm^2 at 80°C. Examination of the irradiated Nb by transmission electron microscopy revealed the formation of defect clusters of interstitials and vacancies in distinct configurations, size ranges, and distribution modes, post-irradiation annealing at temperatures Tsub(a) between 350 and 1000°C produced three main events. At intermediate Tsub(a) up to 500°C, annealing was mainly to transform the complex interstitial clusters into simple loops. Between 500 and 700°C, the shrinkage and the eventual disappearance of the majority (approximately 80%) of the interstitial loops dominated the annealing phenomenon. Although the growth of the vacancy loops was detected even at low Tsub(a),

it became a main event only when Tsub(a) exceeded 700°C. Despite the second main event, many interstitial loops persisted at Tsub(a) as high as 1000°C. Whenever resolvable, the defect clusters of both interstitials and vacancies were found to lie on the brace111brace planes with b = (a/2)<111> normal to the loop planes. The three main events are explicable in terms of two major processes of annealing. One process involves a maximum of three mechanisms - a <001> shear, a rotation of the loop from brace110brace to brace111brace and the glide of prismatic loops - which enable multilayered interstitial clusters to become single-layered loops. The other major process is the migration of vacancies responsible for the second and third main events.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 42113

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 42303, 43154, 43254

43320 (AD-A—048200) **Field electron and ion source research for high density information storage system. Interim technical report No. 1, 15 May—15 Aug 76.** Swanson, L.W. (Oregon Graduate Center, Beaverton (USA)). Apr 1977. Contract F33615-76-C-1327. 87p. NTIS PC A05/MF A01.

The purpose of this research program is the development of high brightness field emission sources of both ions and electrons by use of field emission phenomena. Fabrication procedures and evaluation of emission characteristics have been examined for lanthanum hexaboride field electron emitters. Field electron emission from a liquid gallium source has also been developed and examined. Emission occurs in a pulse mode with 50 to 100 A peak currents in 10 nsec pulses. Gas phase field ion emission using hydrogen has been examined using a high pressure source configuration. Current intensities of 0.00005 A per sr per torr at 77 K were measured. In addition, a preliminary investigation of ion emission from a liquid gallium source has shown that stable currents up to 150 μA can be obtained.

43321 (SAND—78-0555C) **Titanium diboride coatings and their interaction with the substrates.** Pierson, H.O.; Randich, E. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 49p. (CONF-780430—3). Dep. NTIS, MF A01.

From Conference on metallurgical coatings; San Francisco, CA, USA (3 Apr 1978).

Portions of document are illegible.

An experimental investigation of the chemical vapor deposition (CVD) of titanium diboride (TiB_2) on metallic substrates, using the hydrogen reduction of $TiCl_4$ and BCl_3 at 1 atmosphere and at temperatures between 850°C and 1050°C is described. To be coated, the substrate had to meet the following requirements: (1) ability to withstand the deposition temperature without detrimental transformation, (2) chemical inertness to the by-products of the reaction (mostly HCl), (3) reasonable matching of its thermal expansion with that of TiB_2. The latter requirement may be partially circumvented by using a ductile intermediate coating such as Cu or Ni. Substrates meeting these requirements were W, Ta, Ni, WC, TiC, Kovar and some high chrome steels. Coatings on these substrates were examined by metallographic techniques, scanning electron microscope, x-ray diffraction and electron microprobe. The structures and the degree of interdiffusion were determined. In most cases, intermediate borides of the type M_3B and M_2B were formed. The hardness of the coatings was 3330 +- 310 kg/mm² (VHN_{50}). Coatings of TiB_2 have already been used successfully on letdown valves in a bench scale coal liquefaction reactor at Sandia Laboratories.

43322 **Crystal growth of calcium oxide from the molten solvent LiF—20 mole % CaF_2.** Finch, C.B.; Clark, G.W.; Abraham, M.M. (Oak Ridge National Lab., TN). *J. Cryst. Growth;* **39**: 223-226(1977).

Calcium oxide single crystals up to 2 x 2 x 3 mm in size were grown from the molten solvent LiF-20 mole percent CaF_2 in the temperature range 1200-1250°C. A thermal gradient technique (10° C/6 cm) with sealed platinum vessels was used for runs up to four weeks in duration. The best crystals are colorless, transparent rectangular parallelepipods, with good (100) facial development. The crystals were identified by x-ray diffraction, which indicated a lattice parameter of 4.8100 +- 0.0002 A. The principal impurities in inclusion-free crystals are 1000 ppM F and 100 ppM Li. The technique was used to prepare CaO crystals intentionally doped with Gd.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 42905, 43322, 43328

43323 (SAND—77-1815C) **Election paramagnetic resonance studies on Al centers in vitreous silica.** Brower, K.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780332—1). Dep. NTIS, PC A02/MF A01.

From Conference on the physics of SiO/sub 2/ and its interfaces; Yorktown Heights, NY, USA (22 Mar 1978).

Two new aluminum spectra have been observed with EPR in irradiated vitreous silica. Under electron irradiation at 4°K, the low temperature (LT) Al spectrum is produced, and it changes into the high temperature (HT) spectrum upon annealing between 230 and 330°K. The HT Al spectrum is also produced directly upon irradiation at room temperature. Each spectrum is characterized by six well resolved ^{27}Al (I = 5/2) hyperfine lines (A/sub isotropic/(LT) = 0.00330 cm^{-1} and A/sub isotropic/(HT) = 0.0410 cm^{-1}). These spectra are the most intense in type I and II vitreous silicas which contain Al as a natural impurity. The difference in these spectra may reflect the presence of a neighboring charge compensator, such as an alkali, which becomes mobile at approximately equal to 270°K. It is possible that these spectra correspond to Al E_1'-type centers with the unpaired electron strongly localized on a substitutional Al which is bonded to only three oxygen atoms.

43324 **Edge-defined, film-fed growth of Mn_2SiO_4—MnO eutectic composites: effect of die-top geometry on solidification interface shape.** Finch, C.B.; Holder, J.D.; Clark, G.W.; Yakel, H.L. (Oak Ridge National Lab., TN). *J. Cryst. Growth;* **37**: 245-252(1977).

The effect of die-top geometry (planar, convex, or concave) on solidification interface shape was investigated during edge-defined, film-fed growth (EFG) of Mn_2SiO_4-MnO eutectic composites. The composites were solidified as a function of growth rate (3 to 30 mm/h) from melts of the initial compositions Mn_2SiO_4-15 and -29 mole percent MnO. Banding effects attest that the solidification interfaces have contours which approach the die-top geometries used. An aligned microstructure of less than 1 μm diameter MnO rods in an Mn_2SiO_4 matrix was obtained at growth rates of less than 15 mm/h. Discontinuities in rod growth at 1 to 5 μ m intervals suggest mock lateral growth of the matrix. Independent of die-top geometry, an unbanded cellular microstructure predominated in boules grown at 20 mm/h or more.

43325 **Band structure of cubic Na/sub x/WO_3.** Kopp, L.; Harmon, B.N.; Liu, S.H. (Ames Lab., IA). *Solid State Commun.;* **22**: 677-679(1977).

The band structures of cubic WO_3 and $NaWO_3$ have been calculated, and they are shown to be nearly identical, demonstrating the validity of the rigid band model for different sodium concentrations. To elucidate the nature of the bonding, the density of states is decomposed into its s, p, and d contributions from each atomic site.

43326 **Electronic structure of the F center in the alkaline earth oxides.** Wilson, T.M. (Oklahoma State Univ., Stillwater); Wood, R.F. *J. Phys. (Paris), Colloq.;* **37**: No. 12, 190-196(Dec 1976).

The energy levels and wave functions of the ground and first few singlet and triplet excited states of the F center in MgO, CaO and SrO have been calculated as a function of the nearest neighbor ion positions. Configuration coordinate curves for A/sub 1g/, E/sub g/ and T/sub 2g/ displacements have been constructed and used to interpret the absorption and luminescence bands of the F center. The energy of the $^1A/sub\ 1g/ \rightarrow {}^1T/sub\ 1u/$ transition was set near the experimental value in each case by adjusting certain parameters in the model. The calculated energy level schemes partially support the interpretations of published experimental data on the luminescence bands in MgO and CaO and suggest that the $^3T/sub\ 1u/ \rightarrow {}^1A/sub\ 1g/$ luminescence in SrO should occur at roughly 0.6 eV. A luminescence band associated with the F center in SrO has not yet been reported. Calculations of the Jahn Teller coupling constants indicate that the $^3T/sub\ 1u/$ state is strongly coupled to the E/sub g/ vibrational mode in CaO and to the T/sub 2g/ mode in MgO and SrO.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 43277

43327 (N—78-10098) **The promise of eutectics for aircraft turbines.** Gray, H.R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1977. 21p. (NASA-TM—73714; E—9258). NTIS PC A02/MF A01.

The current status of the first generation eutectics, gamma/gamma transition - delta and NiTaC-13, is described in detail. Several second generation systems, such as gamma/gamma transition - alpha and NiTaC 3-116A, gamma - beta, and CoTaC 74 are also reviewed with particular emphasis on their critical physical and mechanical properties, future research directions, and potential applications. Results of recent cost-benefit analyses of eutectic turbine blades are discussed.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 43287, 43320, 43374

43328 (AD-A—047939) **Microstructure, electronic properties and chemical durability of vanadium pentoxide-based glasses and glass-ceramics. Final report 1 Nov 74—30 Apr 77.** Fahmy, A.A. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Science). 1 Jun 1977. 43p. NTIS PC A03/MF A01.

Crystallization of Vanadium Pentoxide from Vanadium Pentoxide-Phosphorous Pentoxide glasses containing 0-9 mol% Boron Trioxide during heat treatment in the range 220 C-410 C caused progressive microstructural changes which dramatically affected the electronic conductivity, the activation energy for conduction, and the resistance to chemical attack. All compositions were approximately 83% crystalline after heating to 410 C. As a result, the values of conductivity and activation energy were almost identical to those observed for pure polycrystalline Vanadium Pentoxide.

43329 (CONF-771127—17) **Crystal field properties of $Yb_2Ti_2O_7$.** Dunlap, B.D.; Shenoy, G.K.; Friedt, J.M.; Meyer, M.; McCarthy, G.J. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From 23. conference on magnetism and magnetic materials; Minneapolis, MN, USA (8 Nov 1977).

Electronic properties of Yb^{3+} in $Yb_2Ti_2O_7$ were investigated using the 84.6 keV Mossbauer transition in ^{170}Yb. The crystal field parameters were deduced by analyzing spectra taken in various externally applied magnetic fields up to 32 kG at temperatures of 4.2 K and 1.6 K. Because of the hexagonal point symmetry at the Yb ion, the crystal field levels are sensitive to the direction of the applied field relative to the c axis. As a result, a proper discussion of the field and temperature dependence of the hyperfine parameters is not possible for a powder sample without a careful average over angles. Such an analysis then yields a value for the crystal field parameter B_2^0 in the range 15 to 21 K and B^0_4/B^0_2 approximately equal 0.01. These parameters and the resulting crystal field eigenfunctions were used to explain the small quadrupole interaction present in this material.

CORROSION AND EROSION

43330 (AD-A—047938) **Environmental effects upon the time-dependent fracture of silicon nitride and silicon carbide. Final report 1 Jun 74—31 Aug 77.** Tressler, R.E. (Pennsylvania State Univ., University Park (USA). Dept. of Material Sciences). 7 Nov 1977. 11p. NTIS PC A02/MF A01.

The great advantages, in terms of economy and performance, to be gained by using high performance ceramics in applications such as the gas turbine engine have spurred development efforts in the non-oxide ceramic area and in hardware applications. However, relatively little effort has been devoted to examining in detail the factors which may limit lifetimes in the above applications in which long lifetimes have been traditionally demanded. The purpose of this research project was to use a fundamentally based fracture mechanics approach to examine the susceptibility of Si_3N_4 and SiC ceramics to stress-corrosion in water and various gaseous environments over a range of temperatures. Further, the fundamental mechanism(s) which contribute(s) to the observed slow crack growth were to be elucidated. In addition, an effort was initiated to investigate the mechanism(s) by which molten salt environments may limit strengths and lifetimes of these materials.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 43323

43331 (SAND—77-1885C) **Vibrational and electronic spectroscopy of ion-implantation-induced defects in fused silica and crystalline quartz.** Arnold, G.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780332—3). NTIS, MF A01.

From Conference on the physics of SiO/sub 2/ and its interfaces; Yorktown Heights, NY, USA (22 Mar 1978).

Portions of document are illegible.

Defects produced by implantation of various atomic species in fused and crystalline SiO_2 were studied using infrared reflection spectroscopy (IRS) with UV-visible spectroscopy. We observe a new vibrational band at 830 cm^{-1} which is tentatively associated with the creation of two nonbridging O atoms in SiO_4 units. Numerous chemical effects were also observed, including evidence for chemical incorporation of Li and anomalously large O-vacancy production for Al^+, B^+ and Si^+ implantation.

43332 (UCID—17786) **DT fusion neutron irradiation of ORNL magnesium oxide crystals and BNL—LASL superconductor wires.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Apr 1978. Contract W-7405-ENG-48. 6p. Dep. NTIS, PC A02/MF A01.

The DT fusion neutron irradiation of two ORNL magnesium oxide crystals and eleven BNL-LASL superconductor wires is described. The sample position and neutron dose record are given. The maximum neutron fluence on any sample was 2.16 x 10^{16} neutrons/cm^2.

43333 **Effect of self-radiation on crystal volume.** Nellis, W.J. (Univ. of California, Livermore). *Inorg. Nucl. Chem. Lett.;* **13**: 393-398(1977).

A phenomenological model is developed to explain the exponential time dependencies commonly observed for the lattice parameter, a, of actinide compounds, i.e., $\Delta a/a = A\ (1 - e/sup\ -Bt/)$. The model assumes that isolated Frenkel defects are produced at a constant rate by approximately 5-MeV α particles emitted by actinide nuclei and that these defects anneal at a rate proportional to the number present. The model is shown to be consistent with published, room-temperature data for the actinide dioxides. However, systematic measurements taken as a function of temperature are needed to determine the energetics of the annealing process.

COMPOSITE MATERIALS

43334 **Development and application of composite materials based on coal and high molecular weight compounds (composition, properties, and fields of application).** Gorlov, E.G. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 1-11(Jan 1977).

A review of the properties of coal-filled plastics including information on their use in various branches of technology is presented.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 43336

43335 (LA-UR—78-884) **Structure and mechanical properties of Al—Al/sub x/O/sub y/ vacuum deposited laminates.** Springer, R.W.; Catlett, D.S. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 26p. (CONF-780430—1). Dep. NTIS, PC A03/MF A01.

From Conference on metallurgical coatings; San Francisco, CA, USA (3 Apr 1978).

Portions of document are illegible.

High yield strength materials can be fabricated by many techniques. A method proposed by Koehler is to alternate thin layers of a high shear modulus material with that of a low shear modulus material. The layers must be less than one hundred atomic layers in thickness and be single crystals of similar lattice spacing epitaxially grown on top of each other. The mechanical effect would be to inhibit dislocation formation and mobility of dislocations through the solid. As such, the stress required to move a dislocation through the laminate can be on the order of 1% of the lower modulus material. A novel technique has been developed to produce a laminate of Al-Al/sub x/O/sub y/ by a Pulsed Gas Process (PGP) in an electron beam gun system. Samples of 25 micro-meters and thicker have been readily produced. The surface finish of the growing deposit appears to remain as smooth as the glass substrate. The tensile testing data show the material to obey a Hall-Petch relation for yield strengths of layer spacings of 50nM to 1200nM. The friction stress was measured directly from a pure vapor deposited sample at 27MPa. The K value was found to be .086 $MN/m^3/2$. These results could also be interpreted in terms of a sub-grain strengthening concept.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 43338, 43339

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 43335

43336 (BNL—24215) **Concrete polymer materials for geothermal applications.** Zeldin, A.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 24p. (CONF-780611—1). Dep. NTIS, MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

Portions of document are illegible.

The feasibility of using a copolymer composed of styrene, acrylonitrile, and acrylamide or methacrylamide in the formation of a high-strength thermally and chemically stable polymer concrete for use in geothermal environments has been demonstrated. Specimens produced with the copolymer in conjunction with an aggregate containing sand and portland cement had compressive strengths

in the range 25,000 to 30,000 psi at 20°C and were thermally stable up to approximately 240°C. A study of the effect of monomer concentration on the properties of the polymer concrete indicated that the optimum concentration is in the range 12 to 13 wt %. Increased monomer concentrations lead to a nonuniform polymer distribution within the composite, resulting in a deterioration of the properties. The optimum properties are obtained when the monomer is used in conjunction with an aggregate containing 70 to 80 wt % silica sand and 20 to 30 wt % portland cement. The results from laboratory and field evaluations in progress indicate that the materials can be used for pipe or as protective liners on pipe and vessels in electric generating and direct utilization geothermal processes.

43337 (UCRL—13836) **Study of time related properties of concrete.** (EA and T Co., Inc., Marina del Rey, Calif. (USA)). Dec 1977. Contract W-7405-ENG-48. 81p. Dep. NTIS, PC A05/MF A01.

The results of a literature survey conducted on the long time properties of reinforced concrete are presented as a means of evaluating the integrity of the high level neutralized waste tank vaults at the Nuclear Fuel Services (NFS) site. The long time behavior or reinforced concrete under conditions of humidity, moisture, temperature, and pressure differentials is discussed. An evaluation of the degree of NFS tank vaults' structural integrity degradation with time is made.

43338 (UCRL—50019-77-2) **Organic Materials Division quarterly report, April—June 1977.** Lepper, J.K. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jan 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Separate analytics were prepared for three sections of this report.

43339 (UCRL—50019-77-2, pp 1-2) **Composite technology.** 19 Jan 1978.

In Organic Materials Division quarterly report, April—June 1977.

Crystal structure of Kevlar 49, strength retention of Kevlar 49/epoxy composites under sustained load, and composite properties of Kevlar 49 fiber in a room-temperature-curable epoxy matrix were studied. Progress in this research is summarized. (GHT)

PHYSICAL PROPERTIES

43340 (UCRL—13840) **Coefficient of friction between carbon steel and perlite concrete surfaces. Test report.** (EA and T Co., Inc., Marina del Rey, Calif. (USA)). Jan 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The results of coefficient of friction, μ, tests conducted on perlite blocks and carbon steel plates under various conditions are discussed. Variables included in the test entailed the use of lubricants (i.e. water and simulated radioactive waste solution) abrasives (120 grit, 60 grit, 40 grit sand paper) applied to the surfaces of the perlite block and carbon steel plates.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

43341 (UCRL—52434(Vol.1)) **Development of alternate silicone potting compounds. Vol. 1. Experimental program.** Cady, W.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

A cooperative program between Lawrence Livermore Laboratory and Pantex was devised to develop silicone potting compounds to replace those discontinued by Dow Corning Corporation. The substitutes are based for the most part on commercially available Dow Corning products that are very similar chemically to the discontinued products.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 43338, 43339

43342 (BDX—613-1816) **Chemical and physical characterization of a Kevlar-filled epoxy molding compound.** McFarland, J.W. (Bendix Corp., Kansas City, Mo. (USA)). Apr 1978. Contract EY-76-C-04-0613. 16p. Dep. NTIS, PC A02/MF A01.

An epoxy molding compound filled with 6 mm Kevlar fibers (E-20328), made by the Fiberite Corporation, has been characterized chemically and physically. The resin is an epoxy novolak and Kevlar is an aromatic polyamide. E-20328 has very good mechanical and electrical properties at 24°C, but these properties fall off sharply at 205°C. Transfer molded specimens had approximately half the flexural strength of compression molded specimens.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 42433, 43252, 43342

DEGRADATION AND EROSION

REFER ALSO TO CITATION(S) 42589

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 42431, 42432, 42434, 42436, 42440, 42441, 42443, 42444, 42450, 42451

43343 (AD-A—048019) **The effect of ion irradiation on the intrinsic stress and substrate adhesion of germanium films. Technical report.** Hirsch, E.H.; Varga, I.K. (Weapons Research Establishment, Salisbury (Australia)). Aug 1977. 13p. (WRE-TR—1832(A)). NTIS PC A02/MF A01.

Irradiation with argon ions is shown to increase greatly the adhesion of vacuum evaporated germanium films on glass and other substrates. The observations suggest that the effect is due to the penetration of Ge atoms into the substrate after collison with the energetic ions. In addition, the intrinsic stress of films deposited under ion bombardment is found to be substantially lower than that of similar films, produced without simultaneous irradiation.

43344 **Method of making shaped carbonaceous bodies.** Luhleich, H.; Nickel, H.; Dias, F. (to Kernforschungsanlage Juelich GmbH). US Patent 4,059,682. 22 Nov 1977. Priority date 2 Jul 1971, German, Federal Republic of (F.R. Germany). 4p.

Shaped graphitic or graphite-like carbonaceous bodies are produced by forming binder-coated particles of a carbonaceous filler in a slurry, shaping the slurry of paste of the particles to the desired configuration, drying and cokefying the shaped body. The system is suitable for the production of graphitic structures for use in high-temperature gas-cooled nuclear reactors, as casting molds and the like. The present invention starts with the assumption that binder-coated filler particles are available, the particles having been coated uniformly.

STRUCTURE AND PHASE STUDIES

43345 **Magnetic correlations in $Rb_2Mn_{0.5}Mg_{0.5}F_4$.** Cowley, R.A. (Brookhaven National Lab., Upton, NY); Shirane, G.; Birgeneau, R.J.; Guggenheim, H.J. *Physica, B, C;* **86-88**: 727-728(1977).

Neutron scattering measurements in the dilute antiferromagnets Rb_2Mn/sub c/Mg/sub 1-c/F_4 with c = 0.54 +- 0.02, 0.57 +- 0.02 have been performed. The critical scattering intensity diverges for $T \rightarrow 0$ until the correlation length exceeds the size of the clusters. Classical random-walk calculations are presented which elucidate the important physical effects near the percolation point.

43346 **Raman—Brillouin light scattering determination of the structural correlation range in GeS_2 glass.** Nemanich, R.J.; Gorman, M.; Solin, S.A. (Univ. of Chicago). *Solid State Commun.;* **21**: 277-280(1977).

Polarized Brillouin and low frequency (3 cm^{-1} less than or equal to omega less than or equal to 40 cm^{-1}) Raman spectra of GeS_2 glass have been measured. Parameters determined from the Brillouin spectra have been used in the theory of Martin and Brenig to obtain from a fit of the Raman spectrum the structural correlation range, 2 sigma. We find 2 sigma equals 8 +- 1 A.

43347 **First evidence for vibrational excitations of large atomic clusters in amorphous semiconductors.** Remanich, R.J. (Univ. of Chicago); Solin, S.A.; Lucovsky, G. *Solid State Commun.;* **21**: 273-276(1977).

Raman and depolarization spectra of $GeSe_2$ alloyed with Se or As_2Se reveal a sharp vibrational doublet, only one component of which can be attributed to a vibrational excitation of the $GeSe_2$ local atomic cluster. The composition dependence of the intensity and polarization of the second feature identify it as an excitation involving a substantially larger cluster with high symmetry. The large cluster is a ring of Ge atoms inter-connected through single Se atoms.

43348 **Direct lattice imaging of polytypes in YSeF.** van Dyck, D. (Rijksuniversitair Centrum Antwerpen, Belgium); van Landuyt, J.; Amelinckx, S.; Huy-Dung, N.; Dagron, C. *J. Solid State Chem.;* **19**: 179-192(1976).

High-resolution imaging was used to study a series of different YSeF polytypes. By comparing the images with the known structures of a few of them that had previously been characterized by x-ray diffraction, an imaging code could be derived which allows

one to deduce the structures of the other polytypes from their lattice images. Mixtures of polytypes and, in some cases, frozen-in defects associated with their formation could be identified. Optical simulation of the electron diffraction patterns by means of simplified polytype models shows a fairly good agreement with the electron diffraction patterns and provides a complementary tool for the identification of the polytypes especially in those cases where no lattice images could be obtained.

43349 Resonant Raman scattering in mixed GaS/sub x/Se/sub 1-x/ crystals. Chiang, T.C.; Camassel, J.; Shen, Y.R.; Voitchovsky, J.P. (Univ. of California, Berkeley). *Solid State Commun.;* **19**: 157-159(1976).

One- and two-phonon resonant Raman scattering around the absorption edge in mixed GaS/sub x/Se/sub 1-x/ crystals with 0 less than or equal to x less than 0.23 has been measured. The results can be explained by a simple theory in which the dispersion of RRS is dominated by exciton resonances.

PROPERTIES

REFER ALSO TO CITATION(S) 42982

43350 (HMI-B—234) **Calculation of implantation profiles.** Altenhein, F.K.; Fuchs, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kernchemie und Reaktor). May 1977. 66p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The report deals with the calculation of implantation profiles obtained after nuclear reactions and elastic neutron scattering. While the basic mathematical treatment of this problem has a large number of applications, the report is particularly concerned with the processes leading to particle implantation in the inner blanket of a DT fusion reactor. For example, in the case of helium cooling, elastic scattering with neutrons results in helium implantations into structural material which is in contact with the gas flow. In the same way, lithium is transported from the Li blanket into the surrounding walls. The breeding reaction $^{6}Li(n,\alpha)^{3}H$ leads to the implantation of helium and tritium.

43351 (SAND—78-0300) **Optical and physical properties of evaporated PbS film.** Landry, M.J.; Langley, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

The density, void volume, thickness, reflectivity and crystal size of vacuum-vapor-deposited Pb_1S/sub X/ films. Volume film density, as determined from film thickness and areal film density measurements, varied from 2.96 to 3.82 g/cm^3 or approximately one-half the density of bulk PbS (rho = 7.5 g/cm^3). Film void volume measured from 49 to 61%. Film thicknesses measured with the Stylus and Interferometer Methods were inaccurate for deposited Pb_1S/sub X/ film (from 80 to 1650 nm Pb_1S/sub X/ film thickness) but accurate for film overlaid with approximately 100 nm of Al (from 160 to 890 nm Pb_1S/sub X/ film thickness). The Ion Backscattering Method yielded accurate X values from 0.92 to 0.97 and areal density values from 0.14 to 1.68 x 10^{18} Pb atoms/cm^2. However, the film thicknesses calculated assuming the volume film density to be that of bulk PbS were approximately a factor of two too small. Specular reflectivity at 45^0 of the film-to-glass interface of prism substrates measured at lambda = 1060 nm decreased with increasing evaporation time at a constant evaporation rate and film thickness, and approached 12% for the longest evaporation time of 6 hours or thickest film studied. Internal reflection of the glass surface approached 100 percent with no film. The shiny appearance of the air interface of the film became mat and sooty for reflectivities of <27%. The film exhibited two sizes of crystals with the smallest located near the film-to-glass interface (length approximately 500 nm, width approximately 20 nm). The size of the larger crystals (length 200 to 1700 nm, width 30 to 600 nm) increased with increasing evaporation time for constant rate, increasing film thickness, and decreasing film-to-glass reflectivity. A combination of the Stylus, Interferometer, and Ion Backscattering Methods is useful in determining the density and void volume of evaporated films.

43352 Crystal structure of lithium uranate. Gebert, E.; Hoekstra, H.R.; Reis, A.H. Jr.; Peterson, S.W. (Argonne National Lab., Ill. (USA)). *J. Inorg. Nucl. Chem.;* **40**: No. 1, 65-68(1978).

Lithium uranate, Li_2UO_4, crystallizes in an orthorhombic unit cell, space group, Pnma(D^{16}/sub 2h/, No. 62) with a = 10.547(3), b = 6.065(1), c = 5.134(1)A and Z = 4. Single crystal X-ray diffraction data complete to 2theta = 50^0 were collected on a Syntex $P2_1$, automated diffractometer. The structure was solved by a combination of Patterson, Fourier, and least-squares refinement techniques to an R/sub F/ = 0.061 for 321 independent reflections. The structure consists of octahedrally coordinated U(VI) ions bonded to two crystallographically different primary oxygens at distances of 1.97(2) and 1.92(2)A and to four equivalent secondary oxygens at 2.19(1)A. Octahedrally coodinated Li(1) and tetrahedrally coordinated Li(2) form Li-O bonds of lengths varying from 1.91(5) to 2.29(2)A.

43353 Electronic properties of polymers. Kepler, R.G. (Sandia Labs., Albuquerque, NM). pp 637-676 of Treatise on materials science and technology. Vol. 10, Part B. New York; Academic Press, Inc. (1977).

Even though knowledge of the electronic properties of polymers is still in the very early, elementary stage, tremendous advances have been made in the last ten years. Many of these advances were stimulated by the application of the electronic properties of polymers in electron photographic processes and in electret microphones as well as by the use of polymers in scintillators and dosimeters. Suggestions that other applications might be possible—for example, to make very cheap semiconductor devices or superconductors with transition temperatures of 2000 K—have also stimulated, and will continue to stimulate, work in this area. Studies of the fundamental properties of organic molecular crystals, as well as of charge transport in low mobility and amorphous materials, have played a big role in increasing our understanding of the electronic properties of polymers. Polymers are very complex materials but frequently the insight provided by studies of the simpler systems has made it possible to sort out the important phenomena. In the same vein, it is interesting to speculate about the possible role of liquid crystal phenomena in the area of piezoelectric and pyroelectric effects in polymers. No connection has yet been made but it appears likely that it will. The number of groups interested in the electronic properties of organic solids is growing at a rapid rate and now that some of these properties are being used commercially, it is anticipated that the field will continue to grow rapidly.

43354 Infrared active optical vibrations of graphite. Nemanich, R.J. (Xerox Palo Alto Research Center, CA); Lucovsky, G.; Solin, S.A. *Solid State Commun.;* **23**: 117-120(1977).

The infrared reflectivity of a graphite has been measured for E perpendicular to c and E parallel to c and the frequencies of the "out-of-plane" A/sub 2u/ symmetry mode and the "in-plane" E/sub 1u/ symmetry mode have been determined to be 868 cm^{-1} and 1588 cm^{-1}, respectively. Macroscopic effective charges for each mode have also been calculated, 0.08e for A/sub 2u/ and 0.41e for E/sub 1u/. The assignment of the A/sub 2u/ frequency has enabled us to evaluate the magnitude of a four-body force that has been used to characterize the graphite lattice modes involving out-of-plane displacements.

CHEMISTRY

43355 (CONF-780601—) **52nd colloid and surface science symposium. Proceedings volume.** Fuller, E.L. Jr.; Corbett, H.G. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 301p. Dep. NTIS, PC A14/MF A01.

From 52. colloid and surface science symposium; Knoxville, TN, USA (11 Jun 1978).

Abstracts are presented under the headings: cell/surface interactions, surface properties and reactions of catalysts, solution chemistry of surfactants, dynamic systems, microorganism/surface interactions, gas-solid interactions, biological surfaces, solid sorbents, lung surfactant and intestinal absorption, pigments, and liquid systems. (DLC)

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 42132, 42283, 43600

43356 (PNL—2500(Pt.4), pp 5.0-5.14) **Multitechnology.** Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Analytical techniques are being developed for pollution monitoring and control. The developments reported include instrumental and methodology, direct-inlet mass spectrometry for pollution characterization, trace constituent analysis by laser excitation, and application of holography to environmental problems. (JSR)

43357 Immunochemical characteristics and preparative application of agarose-based immunosorbents. Eveleigh, J.W.; Levy, D.E. (Oak Ridge National Lab., TN). *J. Solid-Phase Biochem.;* **2**: No. 1, 45-78(1977).

The physical and chemical properties of immunosorbents prepared from Sepharose 4B have been studied, with the objective of improving their utility in preparative applications. The most

significant factors influencing efficient use of these immobilized reagents are loss of immunochemical reactivity with increasing protein substitution and the restrictions imposed by the porous nature of the support. Similar effects are observable with controlled-pore glass matrices, but they are of less significance when solid, nonporous supports are used. Considerable improvements in operational efficiencies have been obtained by limiting the amount of protein immobilization and restricting reaction to the more accessible surface regions of the porous supports. Improved operating protocols based on these principles have been adapted to automated chromatographic systems, resulting in a fourfold increase in productive capacity. With the addition of the continuous dialysis and the concentration system described here, routine daily production of gram quantities of specific antibodied from antisera become possible. Similarly, with a knowledge of the basic characteristics of these immunosorbents, it has been possible to increase greatly the efficiency of small-scale apparations and purifications of immunological reagents from listed sources. The general approach toward the practical exploitation of immunosorbents for preparative applications is discussed in the contest of these findings.30i

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 43666

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 43357

43358 Trapping and determination of labile compounds in the gas phase of cigarette smoke. Zeldes, S.G.; Horton, A.D. (Oak Ridge National Lab., TN). *Anal. Chem.;* **50**: No. 6, 779-782(May 1978).

The gas phase of cigarette smoke was trapped and stored on Tenax-GC for subsequent off-site analyses. Specifically, the highly labile compounds isoprene, acetaldehyde, and acrolein were determined quantitatively in the samples which were thermally desorbed in the injector port of a gas chromatograph onto a cooled gas chromatographic column. Optimum conditions were determined for adsorption and desorption of the gas phase, and the effects of aging on the trapped gases were studied. 5 figures, 1 table.

43359 Modification of the arsenic speciation technique using hydride generation. Crecelius, E.A. (Battelle, Pacific Northwest Labs., Sequim, WA). *Anal. Chem.;* **50**: No. 6, 826-827(May 1978).

Published procedures (with modifications) were used for the analysis of arsenic species in geothermal waters, wine, tissue homogenates, and urine. Modifications of the standard system include addition of a water vapor trap to keep water vapor out of the arsine trap, thus disrupting the gas flow rate. The sodium hydroxide trap is adequate for elimination of low levels of carbon dioxide and hydrogen sulfide from the system, but for wine and geothermal waters, samples may require special handling to avoid interferences from these gases. The method of standardizing and "sensitizing" the system is described. The "sensitizing" procedure apparently decreases the number of analyses required to obtain reproducible calibration curves. (FR)

43360 Analysis of complex polycyclic aromatic hydrocarbon mixtures by computerized GC-MS. Hase, A.; Lin, P.H.; Hites, R.A. (Massachusetts Inst. of Tech., Cambridge). pp 435-442 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous components in man's environment. The presence of these compounds in air particulates is well known; less well publicized, but no less worrisome, is the presence of PAH in the aqueous environment (marine and freshwater and sediments). In both cases (air and water), PAH are present as complex mixtures consisting of various isomeric ring systems and various alkyl substituted isomers of the same ring system. Because the individual PAH differ considerably in their toxicity and because different sources produce different mixtures of PAH, it is important to be able to identify and quantitate the specific components in such mixtures. The purpose of this chapter is to review the application of computerized gas chromatographic mass spectrometry to this problem and to present some examples of the GC-MS analysis of PAH mixtures found in the environment.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 42167, 42392, 43510

43361 (BNWL—2100(Pt.4), pp 88-91) **Trace constituent analysis by laser excitation.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 4. Physical and technological programs.

A high-resolution dye laser system has been constructed and used to investigate the optical excitation and fluorescence analysis of xenon gas. A two-photon excitation to the $^1D_2$ state has been observed via the ensuing fluorescence to the intermediate $^3P_2$ state. Theoretical calculations show that the use of counterpropagating beams to remove the Doppler effect should allow isotopically selective analysis.

43362 (UCRL—80778) **Preparation of uranium standard solutions for x-ray fluorescence analysis.** Wong, C.M.; Cate, J.L.; Pickles, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1978. Contract W-7405-ENG-48. 9p. (CONF-780522—6). Dep. NTIS, PC A02/MF A01.

From ANS topical meeting; Williamsburg, VA, USA (15 May 1978).

A method has been developed for gravimetrically preparing uranium nitrate standards with an estimated mean error of 0.1% (1 sigma) and a maximum error of 0.2% (1 sigma) for the total uranium weight. Two source materials, depleted uranium dioxide powder and NBS Standard Reference Material 960 uranium metal, were used to prepare stock solutions. The NBS metal proved to be superior because of the small but inherent uncertainty in the stoichiometry of the uranium oxide. These solutions were used to prepare standards in a freeze-dried configuration suitable for x-ray fluorescence analysis. Both gravimetric and freeze-drying techniques are presented. Volumetric preparation was found to be unsatisfactory for 0.1% precision for the sample size of interest. One of the primary considerations in preparing uranium standards for x-ray fluorescence analysis is the development of a technique for dispensing a 50-μl aliquot of a standard solution with a precision of 0.1% and an accuracy of 0.1%. The method developed corrects for variation in aliquoting and for evaporation loss during weighing. Two sets, each containing 50 standards have been produced. One set has been retained by LLL and one set retained by the Savannah River project (SRP).

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 43360, 43526, 43578, 43618

43363 (IS—4373) **Calculated pressure-broadened linewidths of C_2H_4.** Tejwani, G.D.T.; Yeung, E.S. (Ames Lab., Iowa (USA)). Apr 1978. Contract W-7405-ENG-82. 52p. Dep. NTIS, PC A04/MF A01.

Self-broadened and foreign-gas (N_2 and O_2) broadened linewidths of ethylene at 300K for a wide range of quantum numbers J and K/sub a/, for all three types of bands, were calculated using the Anderson-Tsao-Curnutte theory of line broadening. C_2H_4 has a zero value of the dipole moment in its ground state. Therefore, only the quadrupolar interactions were considered in the linewidth computations. The molecular quadrupole moment tensor of C_2H_4 was taken from Mulder and Huiszoon. Air-broadened linewidths of C_2H_4 at 200K have also been calculated, so that the temperature dependence can be estimated.

43364 (LERC/RI—78/3) **Tabular method for obtaining empirical formulas from high resolution mass spectral data.** Guffey, F.D.; Weber, J.H. (Department of Energy, Laramie, Wyo. (USA). Laramie Energy Research Center). Jun 1978. 39p. Dep. NTIS, PC A03/MF A01.

Processing of high-resolution mass spectral data produces a large number of exact masses of ions for which empirical formulas must be determined. Various methods to obtain empirical formulas from the exact masses are in use, but all methods either require extensive data processing and manipulation or lengthy tables to determine possible formulas. By considering organic ions that contain up to three heteroatoms (N, O, ^{32}S, ^{34}S) using the Kendrick mass scale (CH_2 = 14.0000 mass units), a minimum number of tables, based only on the decimal portion of the mass, were formed. With these tables and the exact mass of the ion, the atomic composition of an ion (C/sub n/H/sub 2n+x/N/sub a/O/sub b/^{32}S/sub c/^{34}S/sub d/) can be determined.

43365 Mass spectral pattern recognition via techniques of mathematical programming. Fausett, D.W. (Colorado School of Mines, Golden); Weber, J.H. *Anal. Chem.;* **50**: No. 6, 722-731(May 1978).

The problem considered is the determination by low-resolution mass spectrometry of the constituent compounds and their relative concentrations in a sample mixture of chemical compounds. The three methods presented for solution of this problem require that a reference set of mass spectra of pure compounds be available that contains the spectra of the dominant compounds present in the mixture. Each method involves the identification of a subset of the reference compounds whose spectra generate the best fit (in some sense) to the spectrum of the sample in comparison with all other possible subsets. The formulation of the three methods of solution and examples of results obtained by the use of each method are presented. Each of the methods of solution has certain advantages

and disadvantages associated with it. Least Squares Approximation is the most widely known and used, and there is a large amount of statistical information available for it. MAD Approximation and Chebyshev Approximation are readily implemented by the use of the simplex algorithm from Linear Programming; this permits sensitivity analyses of the solutions from the final tableaux. The ultimate decision as to which method is preferable is left to the user. 5 tables, 62 references.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 42155, 42158, 42322, 43576

43366 Parametric studies in industrial distillation. Part I. Design comparisons. Tedder, D.W.; Rudd, D.F. (Univ. of Wisconsin, Madison). *AIChE J.;* **24**: No. 2, 303-315(Mar 1978).

Minimum cost surfaces compare eight distillation systems separating ternary feeds. The regions of optimality for various designs depend upon the species separated, but changes in feed composition have characteristic effects on the relative costs. These characteristic effects can be used to generate heuristics in the form of expected regions of optimality, based on composition and simple physical properties. The expected effects, however, are somewhat uncertain, because the costs of designs depend upon many variables in a complex way. Of all factors considered, the vapor requirements for a tower are perhaps the most important, but the tower operating pressure and the required tower should also be considered.

43367 Parametric studies in industrial distillation. Part II. Heuristic optimization. Tedder, D.W.; Rudd, D.F. (Univ. of Wisconsin, Madison). *AIChE J.;* **24**: No. 2, 316-323(Mar 1978).

The venture cost of operating a single distillation tower is examined as a function of the overhead operating pressure, the feed fractional vaporization, and the vapor to minimum vapor rate ratio. One variable is changed parametrically, while the two remaining are fixed at their optimal values. The percentage increase in cost above the minimum is shown. The relative significance of each variable is discussed. A method is presented for estimating the optimal overhead operating pressure of a distillation tower. Simplified methods for calculating relative tower costs are evaluated. These methods utilize estimates of the Underwood minimum vapor rate, the Fenske minimum theoretical stages, and the temperature drop up the tower, or combinations thereof. Consideration of the economic interactions between two towers in a train is also important in the evaluation of alternatives. It is often necessary to neglect any interactions which may occur in order to synthesize highly integrated systems. A study of these interactions between towers in the direct and inverted configurations is presented. Observed interactions between towers in complex design configurations are also discussed.

43368 Parametric studies in industrial distillation. Part III. Design methods and their evaluation. Tedder, D.W.; Rudd, D.F. (Univ. of Wisconsin, Madison). *AIChE J.;* **24**: No. 2, 323-334(Mar 1978).

Distillation networks are described as sets of composition nodes which are used to estimate material and energy balances. Comparisons with equivalent, equilibrium stage models indicate that these simplified design methods consistently result in small, but acceptable, overdesign, even when applied to complex, thermally coupled tower configurations.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 42178, 42349, 42395, 42596

43369 (AD-A—047556) **Chemistry of compounds containing metal-to-metal triple bonds between molybdenum and tungsten. Technical report.** Chisholm, M.H.; Cotton, F.A. (Princeton Univ., N.J. (USA). Dept. of Chemistry). 18 Nov 1977. Contract N00014-76-C-0826. 36p. NTIS PC A03/MF A01.

The preparation, properties, structures, dynamical solution behaviors and reactivities towards small unsaturated molecules (CO2, acetylenes, CO, etc.) are described for a series of molybdenum and tungsten compounds of general formula M2X6 or M2X6-nY, where X Y=R (alkyl), NR2, or, O2CNR2, O2COR or halide, and Cp2M2(CO)4, all of which contain triple bonds between the metal atoms (M=Mo or W). (Author)

43370 (AD-A—047598) **Octa(isopropoxy)dimolybdenum and bis(nitrosyl)hexa(isopropoxy)dimolybdenum. Structure and bonding in compounds containing molybdenum atoms with fourteen valence shell electronic configurations. Technical report.** Chisholm, M.H.; Cotton, F.A.; Extine, M.W.; Kelly, R.L.; Reichert, W.W. (Princeton Univ., N.J. (USA). Dept. of Chemistry). 30 Nov 1977. Contract N00014-76-C-0826. 14p. NTIS PC A02/MF A01.

The compounds Mo2(OPr(i))6(NO)2, I, and Mo2(OPr(i)8, II have been structurally characterized. Each compound has rigorous inversion symmetry and virtual C2v symmetry and in each there is essentially trigonal bipyramidal coordination about each molybdenum atom.

43371 (ORO—1797-80) **High temperature near infrared spectra of water and electrolyte solutions.** Choppin, G.R.; Snyder, W.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). [nd]. Contract EY-76-S-05-1797. 28p. Dep. NTIS, PC A03/MF A01.

Absorption bands of pure water and of four aqueous electrolyte solutions in the region 6200-7400 cm^{-1} have been measured from 0 to 180°C. The observed bands were resolved in Gaussian components. The variation of the resolved sub-bands with temperature and electrolyte is in agreement with their assignment to three spectroscopically distinct species related to the involvement of 0, 1 or 2 of the hydrogens of H_2O in hydrogen bonding.

43372 Purification of anhydrous hydrogen fluoride. Jayawant, M.D.; Meadows, G.W. (to E.I. du Pont de Nemours and Co.). US Patent 4,083,941. 11 Apr 1978. Filed date 18 Apr 1977. 10p.

A process is disclosed for preparing very high purity anhydrous hydrogen fluoride by contacting anhydrous hydrogen fluoride with at least 2.3% by weight of persulfuric acid based on the anhydrous hydrogen fluoride or at least 0.7% by weight of hydrogen peroxide based on the anhydrous hydrogen fluoride at ambient temperature and either at least 0.6% by weight of methanol based on the anhydrous hydrogen fluoride or at least one mole of sulfuric acid per mole of hydrogen peroxide at a temperature of from 0 to 75°C and distilling the resulting mixture to recover very high anhydrous hydrogen fluoride.

43373 Effect of organic additives on micellar systems studied by positron annihilation techniques. Jean, Y.C.; Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *J. Phys. Chem.;* **82**: No. 7, 811-816(6 Apr 1978).

The rate constants for the reactions of positronium with nitrobenzene and cupric chloride in various aqueous micellar systems, such as sodium dodecylsulfate, hexadecyltrimethylammonium bromide, sodium octylsulfonate, hexadecylpyridinium chloride, and Tergitol-NPX, were measured in the presence of organic additives, such as benzene, benzyl alcohol, n-hexane, and 1-hexanol. The results show that the positronium reactivity toward nitrobenzene or cupric chloride substantially increases, when benzene or benzyl alcohol are added to sodium dodecylsulfate, hexadecyltrimethylammonium bromide, and hexadecylpyridinium chloride solutions, whereas only a slight increase was observed in Tergitol-NPX and no increase in sodium octylsulfonate solutions. In the former systems the rate constants are generally higher in the presence of benzene or benzyl alcohol than in aqueous solutions of nitrobenzene or cupric chloride and approach in the case of nitrobenzene values obtained for positronium reactions with nitrobenzene in benzene solution, whereas n-hexane or 1-hexanol generally exhibit only a small effect. A possible explanation for the observed behavior may be that the aromatic additives become incorporated into the micelle, possibly close to the micelle-water interface where they form clusters or aggregates in which the nitrobenzene probe molecules resides. In this benzene-like microenvironment the nitrobenzene molecule exhibits the same reactivity toward positronium as in benzene solutions. By the same token in the case of n-hexane or 1-hexanol additives, the corresponding rates slightly decrease with additive concentration and approach rate constants observed in a n-hexane-like environment. It appears that the positron annihilation technique can provide a sensitive method of studying the microenvironment of probe molecules in micellar systems.

43374 Particle size distribution function of supported metal catalysts by x-ray diffraction. Ganesan, P. (Univ. of Kentucky, Lexington); Kuo, H.K.; Saavedra, A.; De Angelis, R.J. *J. Catal.;* **52**: No. 2, 310-320(Apr 1978).

An X-ray diffraction method which is capable of determining average particle size, microstrain, and the particle distribution function existing in crystalline materials is presented. The method is based on the analysis of a single X-ray diffraction profile. Results obtained on coprecipitated nickel oxide on alumina- and silica-supported catalytic materials indicate that appreciable strains exist. It is suggested that the strains present in NiO could be due to the pressure developed in the small particles to balance the surface tension forces and the distortion produced by the deformation of face-centered cubic structure into a rhombohedral form. The changes in particle size distributions observed during sintering determined from three catalytic materials provide evidence that particle growth takes place by atomic migration mechanism. In one material the particle growth during sintering appears to be controlled predominantly by crystallite migration and coalescence. The sintering behavior appears to be controlled by the extent of the bimodal

character of the initial distribution function and the average particle size in the as-received condition.

43375 Thermodynamic quantities for the ionization of water in sodium chloride media to 300°C. Busey, R.H.; Mesmer, R.E. (Oak Ridge National Lab., TN). *J. Chem. Eng. Data;* **23**: No. 2, 175-176(Apr 1978).

The thermodynamic quantities at the saturation pressure for the dissociation of water at rounded temperatures from 0 to 300°C and ionic strengths to 5 m in NaCl media are presented in tabular form. The thermodynamic parameters were derived by computer from analytical expressions representing Q/sub w/ = $[H^+][OH^-]$ presented in an earlier paper. The small difference in the effect of NaCl over KCl on the ionization of water is briefly discussed.

43376 Long-range order model of aqueous electrolyte solutions. Pytkowicz, R.M.; Johnson, K.; Curtis, C. (Oregon State Univ., Corvallis). *Geochem. J. (Nagoya);* **11**: No. 1, 1-7(Apr 1977).

A partial long-range order model for aqueous electrolyte solutions is proposed to avoid contradictions present in the Debye-Hueckel theory. The partial long-range order increases with increasing salt concentration because, as the ions are closer together, the coulombic energy of interaction which generates a quasi-lattice increases. Furthermore, the order decreases with increasing temperature because the thermal energy increases relative to the coulombic attraction of the ions. The long-range order parameter L and a parameter v which results from fluctuations and other effects are obtained for LiCl, NaCl, and KCl by comparing the theoretical configurational free energy to the electrical free energy obtained from the experimental activity coeffcients. The specific interaction and the cluster integral models are discussed briefly at the end of this work.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 42396

ORGANIC CHEMISTRY

43377 Organic primary products and their natural raw materials: coal—petroleum—natural gas—wood—water. Neumann, K.K.; Neumann, H.J. *Chem.: Exp. Didak.;* **2**: No. 1, 9-16(1976). (In German).

A review with 14 references covers the production in Germany and the U.S. of aromatic compounds from coal tar; of acetylene from calcium carbide; of methol and Oxo products from synthesis gas generated from coal, petroleum, or natural gas; of ethylene and lower alkylenes from naphtha; of ethanol by fermentation of plant materials or by hydration of ethylene; and of these organic primary products from carbon dioxide and hydrogen produced in the future by nuclear energy, e.g., by gasification of coal and from decomposition of water via hydrolysis of calcium bromide and calcium bromide regeneration via mercury bromide.

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 43363, 43384

43378 Estimation of the degradation of polyoxyethylene. Baichenko, A.A. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 1, 96-99(Jan 1977).

The effects of chemical and mechanical degradation of polyoxyethylene (POE) on its activity as a coal flocculant have been investigated. The efficiency of POE in the flocculation of coal suspensions depends not only on its average molecular weight, and hence its viscosity, but also on the proportion of the most active high molecular weight fractions which is present. POE which has been degraded chemically or mechanically is less effective than POE of equal average molecular weight obtained by polymerisation of the monomer.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 42140

RADIATION CHEMISTRY

43379 (AD-A—047350) **Radiation chemistry. Report bibliography Nov 60—Jul 77.** (Defense Documentation Center, Alexandria, Va. (USA)). Nov 1977. 256p. (DDC/BIB—77/13). NTIS PC A12/MF A01.

This bibliography contains unclassified-unlimited citations on Radiation Chemistry; chemistry of radiation effects on organic, inorganic, and polymeric components. There is also a cross-section of references on instrumentation and techniques employed in measuring these reactions, and their rates. The four computer-generated indexes provided are Corporate Author-Monitoring Agency, Subject, Title and Personal Author. (Author)

43380 (COO—38-1877) **Radiation Laboratory quarterly report, January 1, 1978—March 31, 1978. NDRL—1877.** (Notre Dame Univ., Ind. (USA). Radiation Lab.). 12 Apr 1978. Contract EY-76-C-02-0038. 49p. Dep. NTIS, PC A03/MF A01.

Progress in various studies is reported including studies on: vapor phase structures of inorganic salts; solvated electrons; exchange perturbation theory for many-electron interactions; concept of orbital following; calculation of vibrational form factors in electron impact excitation; limiting behavior of molecule-molecule inelastic collision amplitude at zero momentum transfer; partially diffusion-controlled reactions of isolated pair in condensed media; field-dependent mobilities, T-R energy transfer between electronically excited argon and ground-state CO_2; dose and dose-rate effects in the radiolysis of liquids; coulombically correlated charge-pair distribution and recombination—the role of non-Gaussian diffusion; nonbonded interactions; pulse radiolysis studies of hydrocarbon radical scavenging processes; oxidation of methoxyhydroxycyclohexadienyl radicals by quinones; reaction of hydroxyl radical with phenol; solvent effects on the lifetimes of photogenerated biradicals; oxidation of amines by triplet duroquinone; production of singlet oxygen from excited states of aliphatic ketones; and measurement of electron spin-lattice relaxation times. (LK)

43381 Tunneling reactions of trapped electrons with added electron acceptors in alcohol glasses at 77 K. Miller, J.R. (Argonne National Lab., IL). *J. Phys. Chem.;* **82**: No. 7, 767-774(6 Apr 1978).

The kinetics of reactions of several electron acceptors with trapped electrons in alcohol glasses at 77 K have been studied from 10^{-7} to 10^{2} s by pulse radiolysis. In EtOH glass, where the traps progressively deepen with time, weak acceptors capture only the shallowly trapped electrons present at short times. Some strong acceptors react more readily with the deeply trapped, than with the shallowly trapped electrons. The observations are qualitatively rationalized in terms of long-range electron transfer (tunneling) reactions, the rates of which depend on Franck-Condon factors for overlap with vibrational states of the products. Spectral changes of the trapped electrons, which occur with or without added acceptors, are attributed to relaxation of the solvent around the electrons. The data do not support the concept that the electrons undergo any transport processes, aside from tunneling to electron-accepting impurities, on the time scale of these experiments.

43382 Radiation chemistry of some simple pyrroles. Duvall, J.J.; Jensen, H.B. (Energy Research and Development Administration, Laramie, WY). *Radiat. Res.;* **72**: No. 3, 402-413(Dec 1977).

Pyrrole, the monomethylpyrroles, and 2,5-dimethylpyrrole have been γ-irradiated. Gaseous products have been quantitatively determined and liquid and residual products have been qualitatively identified. The products indicate that several types of reactions occur including ring rupture, cleavage of bonds external to the pyrrole ring, ring substitution, and intramolecular rearrangement. A brief comparison is made among radiolysis, photolysis, mass spectral ionization, and pyrolysis reactions of pyrrole compounds.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

43383 CAMAC automated nuclear chemistry laboratory. Perry, D.G. (Los Alamos Scientific Lab., N.Mex. (USA)). *Nucl. Instrum. Methods;* **147**: No. 3, 615-617(15 Dec 1977).

A large complex of nuclear chemistry laboratories and counting rooms has been automated using CAMAC as the interface to experimental data-acquisition equipment. It is shown that CAMAC provides the versatility required in a complex experimental laboratory where requirements change from one experiment to another, and where many different experiments may proceed concurrently.

HOT-ATOM CHEMISTRY

43384 Reactions of iodine with olefins. 5. The systematics of electrophilic high energy iodine in gaseous, high pressure, and liquid isomers of butene. To, K.C.; Berg, M.E.; Rack, E.P. (Univ. of Nebraska, Lincoln). *J. Phys. Chem.;* **82**: No. 7, 761-766(6 Apr 1978).

Reactions of high energy iodine with isomers of butene were studied in gaseous, high pressure, and condensed phase conditions, with rare gas additives and in the presence and absence of radical scavengers (I_2 and O_2). It was found that the trans-butene-2 system behaves as a hot system while cis-butene-2 and methylpropene (isobutylene) are dominated by I_2-dependent ion-molecule reactions. The diverse and complex nature of the reactions cannot be explained by simple chemical and physical parameters. Comparison with other pi-bond systems demonstrates the preferential attack of iodine at the

double bond and results in the characterization of general traits common to these systems.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 43667

43385 (CONF-780134—2) **Crystal and solution spectroscopy of einsteinium.** Carnall, W.T. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

From Symposium commemorating the 25th anniversary of the discovery of elements 99 and 100; Berkeley, CA, USA (23 Jan 1978).

Work on spectra and electronic structure of Es^{3+} is reviewed. Laser-excited fluorescence spectroscopy was used to study Es^{3+}-doped $LaCl_3$ crystals; fluorescence transitions and lifetimes were determined. A complete ground-state splitting diagram was also constructed for Es^{3+}: $LaCl_3$. Some data on excited states of Fm^{3+} are also included. 12 figures. (DLC)

43386 (ORNL/TM—6365) **Plutonium(IV) and thorium(IV) hydrous polymer chemistry.** Johnson, G.L.; Toth, L.M. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

The recent attention given to Pu(IV) polymers has warranted a review of plutonium and thorium hydrolysis chemistry with respect to the various experimental approaches and insights gained therein. Differing terminologies used in the experimental procedures have often confused the understanding of the chemical processes which occur between the first hydrolysis reaction of the tetravalent actinide and its final dehydration to form the crystalline oxide. This report focuses on the polymer aging reaction which is defined here in terms of A. W. Thomas' ol to oxo conversion reaction and involves simply the conversion of hydroxyl-bridged polymer links to oxygen-bridged linkages. Thorium(IV) hydrolytic reactions are included because they are analogous in many respects to those of Pu(IV) and offer a simpler chemical system for experimental study. Future work using spectroscopic techniques should significantly improve the description of this aging phenomenon.

43387 (PB—273171) **Computer-assisted evaluation of the thermochemical data of the compounds of thorium.** Wagman, D.D.; Schumm, R.H.; Parker, V.B. (National Bureau of Standards, Washington, D.C. (USA); International Atomic Energy Agency, Vienna (Austria)). Aug 1977. 94p. (NBSIR—77-1300). NTIS PC A05/MF A01.

Selected values are given for the thermochemical properties of the compounds of thorium. They are obtained from a computer-assisted least sums-least squares approach to the evaluation of thermodynamic data networks. The properties given, where data are available, are enthalpy of formation, Gibbs energy of formation, and entropy at 298.15 K (Δ Hf (298), Δ Gf (298), and S (298)). The values are consistent with the CODATA Key Values for Thermodynamics. The reaction catalog from which this self consistent set of values is generated is given with a statistical analysis. Some thermal functions are also given, as well as detailed comments when necessary.

43388 (UCRL—52000-78-2, pp 15-22) **Surface and passivation studies of actinide metals.** Feb 1978.

In Energy and technology review.

Results of studies of the molecular and electronic structures of passivation films on actinide metals are presented. Experimental techniques used include law energy electron diffraction, auger electron spectroscopy, photoelectron spectroscopy, and electron-induced luminescence. Experimental production of oxide and oxide-hydroxide films on thorium and uranium is described along with oxidation studies using thorium single crystals. It is felt the efforts in developing fundamental understanding of the reactivity and surface properties of the actinide metals have contributed significantly to the solutions of many applied problems, particularly in the area of materials compatibility. (JRD)

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 43733, 43735

43389 (LBL—6899) **Computational study of physical and chemical flame inhibition.** Brown, N.J.; Schefer, R.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 39p. (CONF-780417—5). Dep. NTIS, PC A03/MF A01.

From Western States Section/Combustion Institute; Boulder, CO, USA (17 Apr 1978).

This paper reports a set of modelling studies that were undertaken to acquire a more detailed knowledge of combustion inhibition mechanisms. $H_2/O_2/Ar$ mixtures reacting in the idealized perfectly stirred reactor were investigated. Three H_2/O_2 kinetic mechanisms were considered, differing from one another by the number of HO_2 reactions included. Two physical inhibitors, Ar and N_2, and one chemical inhibitor, HBr, were investigated. Additional parameters considered were pressure, equivalence ratio, inhibitor concentration and rate coefficient variation. HBr was the most effective inhibitor and acted chemically in that it caused substantial reduction in radical concentrations in the mixtures considered. Ar and N_2 acted as physical diluents with N_2 the more effective of the two due to its larger heat capacity.

ENGINEERING

43390 (UCRL—50016-77-4) **Mechanical Engineering Department quarterly report, October—December 1977.** Stone, R.G.; Bathgate, M.B. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Dec 1977. Contract W-7405-ENG-48. 50p. Dep. NTIS, PC A03/MF A01.

Separate abstracts have been prepared for different sections of the report. (TFD)

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 42400

43391 (BDX—613-2003) **Boundary value determination of contact angle.** Emery, J.D. (Bendix Corp., Kansas City, Mo. (USA)). 1978. Contract EY-76-C-04-0613. 20p. (CONF-780331—3). Dep. NTIS, PC A02/MF A01.

From Conference of mathematical software; Austin, TX, USA (29 Mar 1978).

Success in a soldering operation depends on the ability of the solder to wet the surfaces of the parts to be joined. Wetting is a function of the cleaning method and is measured by the contact angle. This is the angle that has one of its rays tangent to the liquid surface, the other tangent to the solid surface, and its interior in the liquid. The wetting of a solid vertical wall draws the liquid surface upward in the neighborhood of the wall. The resulting height is a function of both the contact angle and the shape of the vertical wall. This height is easier to measure than the contact angle. A method and a program for determining the contact angle from the height when the vertical wall is cylindrical are described. The method involves solution of a two-point boundary value problem with one of the points infinity.

43392 (N—78-11442) **Experimental determination of the temperature field and the thermal stresses on thermally loaded thick-walled structures, Part 2.** Vollhardt, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 1976. 29p. (DLR-IB—152-76/08A). NTIS PC A03/MF A01.

The determination of steady temperature - and stress fields in thermally loaded thick-walled structures, such as thick circular plates, typically used by apparatus and reactor industry are discussed. The experimental technique to determine temperature and thermal stress distributions is described; boundary conditions such as the influence of direct radiation on strain gages and support conditions are investiagted. The results on thick circular plates were compared with those obtained with the finite element method. By considering the unavoidable imperfections in experiments (e.g., construction and application of thermocouples and strain gages), the results of the temperature distribution and the stresses agree very well. The difficulties (e.g., the problem of describing the real support conditions of a plate in the experiment) become apparent.

43393 (SAND—78-0008) **Experimental determination of the effect of the basic mass properties on the drift of an artillery shell.** Rollstin, L.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

The corrosion performance of investment-cast U-0.75 wt % Ti penetrators for the U.S. Air Force rapid-fire gun (GAU-8/A) has been studied in salt-fog and moist-nitrogen environments. The corrosion tests disclosed (1) no evidence of stress corrosion cracking, (2) higher corrosion rates for as-cast lots than those from solution heat-treated and aged lots, and (3) no degradation for encapsulated penetrators in a salt-fog environment. On the basis of the data obtained from these tests it is concluded that heat-treated and aged investment-cast penetrators perform as well as wrought penetrators from the MANTECH I Program.

43394 (SAND—78-0226) **Sandia APT postprocessor for American 4025W N/C lathe with GE 550TX control.** Plomp, P.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 131p. Dep. NTIS, PC A07/MF A01.

The Sandia APT Postprocessor for the American 4025W Lathe with a GE 550TX control reads the cutter-location tape produced by the Sandia APT system and produces a tape which will drive the lathe in the specified pattern. It also produces a listing to match the tape. It is operative on the UNIVAC 1108 under Exec. 8 control. It is also compatible with the Sandia Direct Numerical Control System.

43395 (SAND—78-8009) **Corrosion testing of the General Electric-MANTECH II GAU 8/A penetrator.** Johnson, H.R.; Weirick, L.J. (Sandia Labs., Livermore, Calif. (USA)). May 1978. Contract EY-76-C-04-0789. 37p. Dep. NTIS, PC A03/MF A01.

A series of 8-inch artillery projectiles featuring mass properties variation were fired to determine the effect on crossrange deflection (drift). The results of this experimental program are presented. The drift of a spinning projectile away from the vertical plane of the firing azimuth is primarily caused by the yaw of repose. Analytic expressions for the repose angle and the crossrange deflection or drift have been developed by several authors. Previous analytical work showed that the drift of a spinning projectile is dependent upon the projectile roll moment of inertia and center-of-gravity position, but is independent of the pitch moment of inertia. The present work provides an experimental verification of the previous analyses. This program was conducted in support of the ballistic match effort in which slightly dissimilar projectiles are to have impact points within a specified dispersion, i.e., though the mass properties of two nearly similar projectiles cannot be exactly matched, they can be tailored to provide for similar trajectories. A more accurate analytic expression for the crossrange deflection of a spinning projectile is also developed.

43396 (SAND—78-8012) **Microprocessor-controlled beam deflection system for the Hamilton standard W2 electron beam welder.** Hopwood, J. (Sandia Labs., Livermore, Calif. (USA)). May 1978. Contract EY-76-C-04-0789. 116p. Dep. NTIS, PC A06/MF A01.

Operational, programming, and circuit details are given for a system designed at Sandia Laboratories, Livermore, for preprogrammed controlled movement of the electron beam within the Hamilton Standard Welding Chamber. The system is comprised of two parts, each of which is microprocessor controlled. The desired beam pattern is first drawn on a 20-in. x 20-in. piece of paper and then digitized. Beam rate of travel and dwell time at each point in the pattern are added. The digitized data are processed by part 1 and stored in a portable memory. The memory is inserted in part 2, which is interfaced to the welder. Subsequent controlled movement of the beam takes place. An infinite variety of beam deflection patterns is thus possible. The memory data can be recorded onto magnetic tape for later use. A magnetic tape can also be generated by computer program, so that part 2 can be used when part 1 is not available.

43397 (UCRL—50016-77-4, pp 21-25) **On-line model analysis using the T-DAC computer system.** 31 Dec 1977.

In Mechanical Engineering Department quarterly report, October—December 1977.

A versatile combination of hardware and software on the LLL T-DAC computer system has recently been developed that permits the rapid and accurate modal analysis of complex mechanical structures under field conditions. Natural frequencies of vibration and values of damping are interactively determined from experimental data acquired directly by the system. The computed mode shapes are then illustrated by an animated three-dimensional CRT display.

43398 (Y—2129) **Laser-error-correction control unit for machine tools.** Burleson, R.R. (Oak Ridge Y-12 Plant, Tenn. (USA)). 23 May 1978. Contract W-7405-ENG-26. 134p. Dep. NTIS, PC A07/MF A01.

An ultraprecision machining capability is needed for the laser fusion program. For this work, a precision air-bearing spindle has been mounted horizontally on a modified vertical column of a Moore Number 3 measuring machine base located in a development laboratory at the Oak Ridge Y-12 Plant. An open-loop control system previously installed on this machine was inadequate to meet the upcoming requirements since accuracy is limited to 0.5 μm by the errors in the machine's gears and leadscrew. A new controller was needed that could monitor the actual position of the machine and perform real-time error correction on the programmed tool path. It was necessary that this project: (1) attain an optimum tradeoff between hardware and software; (2) use a modular design for easy maintenance; (3) use a standard NC tape service; (4) drive the x and y axes with a positioning resolution of 5.08 nm and a feedback resolution of 10 nm; (5) drive the x and y axis motors at a velocity of 0.05 cm/sec in the contouring mode and 0.18 cm/sec in the positioning mode; (6) eliminate the possibility of tape-reader errors; and (7) allow editing of the part description data. The work that was done to develop and install the new machine controller is described.

43399 **Nose tip locking device.** Andersen, J.A.; Harty, G.R. (to Energy Research and Development Administration). US Patent 4,065,217. 27 Dec 1977. Filed date 24 Nov 1976. 4p.

PAT-APPL-744,472.

The disclosure relates to a mechanism for releasably locking a nose tip to a vehicle utilizing a pawl and ratchet and pinion arrangement.

43400 **Compact gate valve.** Bobo, G.E. (to Energy Research and Development Administration). US Patent 4,062,515. 13 Dec 1977. Filed date 13 May 1976. 4p.

PAT-APPL-686,446.

This invention relates to a double-disc gate valve which is compact, comparatively simple to construct, and capable of maintaining high closing pressures on the valve discs with low frictional forces. The valve casing includes axially aligned ports. Mounted in the casing is a sealed chamber which is pivotable transversely of the axis of the ports. The chamber contains the levers for moving the valve discs axially, and an actuator for the levers. When an external drive means pivots the chamber to a position where the discs are between the ports and axially aligned therewith, the actuator for the levers is energized to move the discs into sealing engagement with the ports.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 44011

43401 (AD-A—047177) **Theory and design of electrical rotating machinery. Annual report No. 5, 1 Nov 76—31 Oct 77.** Carr, W.J. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Research and Development Center). Nov 1977. Contract N00014-72-C-0432. 21p. NTIS PC A02/MF A01.

The objective of this program is to contribute toward new and improved rotating machines for Naval applications, with emphasis on superconduting machinery. Work has been performed on the theory of ac losses in multifilament superconductors and experiments were made to check the theory. A list of publications and abstracts of scientific papers published under the contract is given. Some work on the design of the iron circuit of a normal homopolar motor was concludeded.

43402 (CONF-780339—1) **Superconducting transistor.** Gray, K.E. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A three film superconducting tunneling device, analogous to a semiconductor transistor, is presented, including a theoretical description and experimental results showing a current gain of four. Much larger current gains are shown to be feasible. Such a development is particularly interesting because of its novelty and the striking analogies with the semiconductor junction transistor.

43403 (CONF-780339—2) **Properties of high temperature SQUIDS.** Falco, C.M.; Wu, C.T. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A review is given of the present status of weak links and dc and rf biased SQUIDs made with high temperature superconductors. A method for producing reliable, reproducible devices using Nb_3Sn is outlined, and comments are made on directions future work should take.

43404 (EPRI-EL—663(Vol.1)) **Superconducting generator design. Final report.** Jefferies, M.J.; Rios, P.A. (General Electric Co., Schenectady, N.Y. (USA)). Mar 1978. 522p. Dep. NTIS, PC A22/MF A01.

This final report, Superconducting Generator Design (RP429-2) in two volumes, is one of two competitive research efforts to evaluate the potential of superconducting generators for electric utility application. The two competitive contracts are numbered RP429-1 and RP429-2. The project was intended to result in the design of both a 300-MVA and a 1200-MVA, superconducting, two-pole ac generator. The general objectives of the project were: (1) to prepare a detailed preliminary design for a 300-MVA and an extrapolated conceptual design for a 1200-MVA superconducting generator; (2) to provide specifications for auxiliaries for each size unit; (3) to make an economic evaluation for comparison between conventional and superconducting generators in terms of user capital and operating costs; and (4) to prepare a future development plant to

move from today's technology to the construction and test of a 300-MVA superconducting generator prototype. Both this project and RP429-1 have concluded that a superconducting generator for utility application is both technically and economically feasible. The report recommends that EPRI sponsor the next logical step, which is to build and test a 300-MVA superconducting generator.

43405 (LA—7249-PR) **Low temperature physics and engineering quarterly progress report, October 1—December 31, 1977.** Keller, W.E. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 42p. Dep. NTIS, PC A03/MF A01.

A summary is given of the significant progress achieved in several programs carried out in the Los Alamos Scientific Laboratory's Low Temperature Physics and Cryogenic Engineering Group during the period October 1 to December 31, 1977. Progress is documented for the following areas: analysis of environment safety and safety controls for hydrogen; assessment of environmental effects caused by large magnetic fields; equation of state of solid and fluid hydrogen and deuterium; magnetic studies of solids at low temperature; experiments dealing with the destruction of superconductivity by current; electrical engineering, cryogenic engineering and cable development aspects leading to a prototype demonstration of a direct current superconducting power transmission line, development of conductors, electrical control apparatus, large dewar vessels, and electrical insulation for superconducting magnetic energy storage devices, as well as designs of these units for power system stabilization; design, testing and procurement of equipment for separating and handling large amounts of tritium-deuterium mixtures for equipment to be used in conjunction with the magnetic fusion programs; experiments related to target preparation for the laser fusion programs; development of practical conductors of Nb_3Ge; and experiments leading to designs for magnetic refrigerators to be used for superconducting device applications in the electric power industry.

43406 (N—78-11200) **Cryogenic foam insulation: abstracted publications.** Williamson, F.R. (National Bureau of Standards, Boulder, Colo. (USA)). Sep 1977. 171p. (NASA-RP—1002). NTIS PC A08/MF A01.

A group of documents were chosen and abstracted which contain information on the properties of foam materials and on the use of foams as thermal insulation at cryogenic temperatures. The properties include thermal properties, mechanical properties, and compatibility properties with oxygen and other cryogenic fluids. Uses of foams include applications as thermal insulation for spacecraft propellant tanks, and for liquefied natural gas storage tanks and pipelines.

43407 (NTIS/PS—77/1158) **Cryogenic refrigeration. Volume 2. 1973-October 1977 (a bibliography with abstracts). Report for 1973-Oct 77.** Reed, W.E. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 234p. NTIS PC N01/MF N01.

Topics in the cited reports include cryogenic cooling of electronic equipment, infrared equipment, cryogenic storage vessels, magnetohydrodynamic generators, and superconducting magnets, coils, rotating machinery, and transmission lines. Marine refrigeration of liquified natural gas, cryogenic heat pipes, cryogenic heat transfer, and space applications are studied. Methods investigated include adiabatic demagnetization, electrocaloric effect, Joule-Thomson effect, thermoelectric cooling, and Crayton, Claude, Gifford-McMahon, Sterling, and Vuilleumier cycles. (This updated bibliography contains 229 abstracts, 76 of which are new entries to the previous edition.)

43408 Method of making an improved superconducting quantum interference device. Wu, C.T.; Falco, C.M.; Kampwirth, R.T. (to Energy Research and Development Administration). US Patent 4,064,029. 20 Dec 1977. Filed date 8 Feb 1977. 4p.

PAT-APPL-766,653.

An improved superconducting quantum interference device is made by sputtering a thin film of an alloy of three parts niobium to one part tin in a pattern comprising a closed loop with a narrow region, depositing a thin film of a radiation shield such as copper over the niobium-tin, scribing a narrow line in the copper over the narrow region, exposing the structure at the scribed line to radiation and removing the deposited copper.

PROTECTIVE STRUCTURES AND EQUIPMENT

43409 (UCID—17758) **Glove permeation by organic solvents.** Nelson, G.O.; Wong, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Fifteen protective gloves with 16 common laboratory solvents to determine permeation rates are tested. Solvents such as methylene chloride, chloroform, methyl iodide, toluene, and 1,1,1-trichloroethane penetrated all gloves within the 60-min test time. Buna-N rubber, neoprene, and latex gloves effectively stopped dimethylsulfoxide. Dynamic gas-phase infrared spectrophotometric techniques were used to make the permeation measurements.

HANDLING EQUIPMENT AND PROCEDURES

43410 (LA—7170-MS) **Experimental criticality specifications. An annotated bibliography through 1977.** Paxton, H.C. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

The compilation of approximately 300 references gives sources of experimental criticality parameters of systems containing ^{235}U, ^{233}U, and ^{239}Pu. The intent is to cover basic data for criticality safety applications. The references are arranged by subject.

43411 (PB—275529) **Transportation of radioactive material by air and other modes. Docket No. Pr-71, 73 (40 Fr 23768). Volume 1. Final environmental statement.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Dec 1977. 353p. (NUREG—0170-VOL-1). NTIS PC A16/MF A01.

This document includes all public comments received regarding the Draft Environmental Statement on the Transportation of Radioactive Material By Air and Other Modes (NUREG-0034) and the NRC Staff responses to those comments. This document also identifies the major changes made from the Draft Statement to the Final Environmental Statement. Volume 1 includes the following topics: Regulations governing the transportation of radioactive materials; Radiological effects; Transport impacts under normal conditions; Impacts of transportation accidents; Alternatives; Security and safeguards; Standard shipments model; Excerpts from code of federal regulations; Plutonium; Population dose formulas for normal transport; Demographic model; Incidents reported to DOT involving radioactive material from 1971 through 1974; Calculation methodology for accident analysis; Method for derating accident severity categories; Sensitivity analysis.

43412 (PB—275530) **Transportation of radioactive material by air and other modes. Docket No. Pr-71, 73 (40 Fr 23768). Volume 2. Final environmental statement.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Dec 1977. 553p. (NUREG—0170-VOL-2). NTIS PC A24/MF A01.

This document includes all public comments received regarding the Draft Environmental Statement on the Transportation of Radioactive Material By Air and Other Modes (NUREG-0034) and the NRC Staff responses to those comments. This document also identifies the major changes made from the Draft Statement to the Final Environmental Statement. Volume 2 includes comments on NUREG-0034 and major changes that have occurred since NUREG-0034 was issued. (Portions of this document are not fully legible)

43413 Shielded container. Czaplinski, T.V.; Heyer, R.E. (to E.R. Squibb and Sons, Inc.). US Patent 4,084,097. 11 Apr 1978. Filed date 15 Dec 1976. 10p.

A shielded container in which a vial containing a radioactive solution is housed is described. The container is constructed so that the activity of the radioactive solution can be measured in a radioisotope calibrator without exposing the technician to potentially harmful radioactivity.

SHIPPING CONTAINERS

43414 (AGNS—1040-14) **Realistic assessment of a nuclear cask during a hypothetical railroad accident.** Anderson, R.T. (Allied-General Nuclear Services, Barnwell, S.C. (USA)). May 1978. Contract ET-78-C-09-1040. 22p. (CONF-780506—25). Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The study results indicate that blindly selecting the "worst-possible-case assumptions", and then postulating a radioactive material (RAM) release without identifiable mechanisms compounds unrealism and adds confusion. In order for a RAM release to occur, an unlikely series of events must first occur which breach the multiple containment barriers surrounding the fuel. The overall safety margin provided by the packaging equipment increases geometrically beyond the already adequate margin provided by each containment barrier. A case evaluation of the NL 10/24 packaging system illustrates this contention by showing that: (1) the accident events which must occur before a release of RAM, other than gases, is possible are in themselves incredible; and (2) the biological effects of a release of fission gases will in all liklihood be nil.

43415 (CONF-780506—21) **ORNL radioactive carrier drop test facility: the design, construction, and operating capability.** Seagren, R.D.; Aramayo, G.A.; Holmes, R.M.; Box, W.D.; Shappert, L.B.; Evans, J.H. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Portions of document are illegible.

A large drop test facility has been constructed at the Tower Shielding Facility (TSF) at the Oak Ridge National Laboratory. A 670- metric ton impact pad was constructed of reinforced concrete and armor plate and located between two 96-m-tall towers of the TSF. The towers, with heavy-duty hoisting equipment attached at their tops, are 39 m apart and are capable of lifting and dropping casks from heights of 60 m. Casks weighing 100 metric tons can be tested at 9 m, whereas lesser weight casks can be handled at greater heights. The design, construction, and operating capability of this facility are desccribed.

43416 (IAEA-AG—63-14) **Some aspects of cleaning and transport of spent fast reactor fuels.** Shirin, V.M.; Karpov, A.V. (International Atomic Energy Agency, Vienna (Austria)). May 1976. 4p. (In Russian). (CONF-760576—38). Dep. NTIS (US Sales Only), PC A01/MF A01.

From IAEA meeting on LMFBR fuel reprocessing; Leningrad, USSR (17 May 1976).

Cleaning and transport of spent fast reactor fuels and utilization of lead for this purposes are considered in this paper.

43417 (NUREG/CR—0071) **Dynamic analysis to establish normal shock and vibration environments experienced by radioactive material shipping packages. Quarterly progress report, October 1—December 31, 1977.** Fields, S.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1978. Contract EY-76-C-14-2170. 39p. (HEDL-TME—78-19). Dep. NTIS, PC A03/MF A01.

The objective of this study is to determine the extent to which the shocks and vibrations experienced by radioactive material shipping packages during normal transport conditions are influenced by, or are sensitive to, various structural parameters of the transport system (i.e., package, package supports, and vehicle). The purpose of this effort is to identify those parameters that significantly affect the normal shock and vibration environments so as to provide the basis for determining the forces transmitted to radioactive material packages. Determination of these forces will provide the input data necessary for a broad range of package-tiedown structural assessments. This is the first quarterly report on this work.

43418 (ORNL—5407) **Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory Foamglas Shipping Container.** Klima, B.B.; Shappert, L.B.; Seagren, R.D.; Box, W.D. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 100p. Dep. NTIS, PC A06/MF A01.

An analytical evaluation of the Oak Ridge National Laboratory (ORNL) Foamglas Shipping Container was made to demonstrate its compliance with the regulations governing offsite radioactive material shipping packages. The evaluation encompassed five primary categories: structural integrity, thermal resistance, radiation shielding, nuclear criticality safety, and quality assurance. The results of the evaluation show that the container complies with the applicable regulations.

43419 (SAND—77-0270) **Analysis, scale modeling, and full scale tests of a truck spent-nuclear-fuel shipping system in high velocity impacts against a rigid barrier.** Huerta, M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 190p. Dep. NTIS, PC A09/MF A01.

The report describes analyses conducted to predict the response of a truck tractor-trailer system with a spent-nuclear-fuel shipping cask in very severe (98 to 135 kilometers per hour) head-on crashes into a rigid concrete structure. The analyses include both mathematical and physical scale modeling of the system. The results of the analyses are compared to the results of instrumented full-scale tests conducted as the last step in the research program described in the report.

43420 (UCRL—52424) **Safety analysis report on Model UC-609 shipping package.** Sandberg, R.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1977. Contract W-7405-ENG-48. 78p. Dep. NTIS, PC A05/MF A01.

This Safety Analysis Report for Packaging demonstrates that model UC-609 shipping package can safely transport tritium in any of its forms. The package and its contents are described. The package when subjected to the transport conditions specified in the Code of Federal Regulations, Title 10, Part 71 is evaluated. Finally, compliance with these regulations is discussed.

TRANSPORT AND STORAGE FACILITIES

43421 **Solid—liquid flow: slurry pipeline transportation.** Wasp, E.J.; Kenny, J.P.; Gandhi, R.L. Clausthal, Ger.; Trans Tech Publications (1977). 224p. $50.00.

Some general aspects of slurry hydraulics and pipeline design are discussed. The information is directed towards the working engineer and the solution of practical problems with examples of their use cited. Data are tabulated on performing commercial slurry pipelines for coal, iron concentrates, copper concentrates, and limestone. Other information is presented on some aspects of fluid flow in pipes; the relative motion of fluids and particles; physical properties of suspensions; suspension of particles in turbulent flow; flow of homogeneous suspensions; flow of heterogeneous suspensions; related topics in slurry handling; mechanical and operational aspects; corrosion-erosion in slurry pipelines; and economic and financial aspects. (MCW]

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 43309

43422 (SAND—77-1962) **Single point rock cutting strength and fatigue evaluation of gas pressure diffusion bonded Stratapax.** Huff, C.F.; Ashmore, R.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 28p. Dep. NTIS, PC A03/MF A01.

Single point rock cutting experiments were conducted to test the competence of the diffusion bonding technique for attaching the General Electric polycrystalline diamond surfaced cutting element (Stratapax) to a stud or bit blank. These tests showed that diffusion bonds which have shear strengths of over 65,000 psi at room temperature performed well in the long-term fatigue environment of cutting various granites on a vertical milling machine. These bonds proved to be superior to conventional low temperature braze bonds which fail because of frictional heating and bond erosion. Before the bond tests were conducted, preliminary experiments were run to determine the response of the Stratapax as a cutting element in an actual rock cutting environment in order to facilitate the bond tests. These tests proved to be very informative in showing the effects of rake angle on Stratapax survival. With negative rake angles of less than 20^0, the forces tangent to the face of the Stratapax cause spalling of the diamond which leads to eventual catastrophic failure of the entire assembly. With negative rake angles greater than 20^0 in the same rocks, the Stratapax did not spall or fail during normal cutting. Measured forces and visual observations of Stratapax while cutting granites, limestone, and sandstone are included. From the data collected on these tests, it was determined that with satisfactory attachment, the proper rake angle, and adequate cooling, Stratapax represents an extremely viable tool for cutting or drilling rock.

43423 (SAND—77-1994) **Stratapax computer program.** Ashmore, R.F.; Chase, K.W.; Mahlum, D.L. (Sandia Labs., Albuquerque, N.Mex. (USA); Brigham Young Univ., Provo, Utah (USA). Dept. of Mechanical Engineering). Apr 1978. Contract EY-76-C-04-0789. 75p. Dep. NTIS, MF A01.

Portions of document are illegible.

Correct placement of Stratapax cutters on a drill bit is of prime importance in order to equalize the volume of rock removed per revolution, to balance torque on the bit, and to equalize wear on the cutters. Initially, placement of the cutters was determined by graphical methods which were time consuming and limited in accuracy. Therefore, criteria for a computer program to perform this function were formulated by Sandia Laboratories personnel; the task of writing the computer program was assigned to a Brigham Young University Mechanical Engineering Professor. The resulting program has been further modified and expanded under contract with Brigham Young University. This effort has resulted in a program which computes the area of rock in contact with each Stratapax cutter, the volume removed per revolution, torque applied to each cutter, and the wear surfaces in contact with the rock. The program is a powerful tool which can be used to design Stratapax drill bits and can also be adapted to other types of drill bits with circular cutters.

43424 **Drilling mud invasion of unconsolidated aquifer materials.** Dudgeon, C.R.; Cox, R.J. Canberra, Australia; Australian Government Publishing Service (1976). 216p.

The problem of formation damage (and the related problem of lost circulation) as relevant to the water well field was investigated. A series of experiments was made in which a range of unconsolidated aquifer materials were exposed to commonly used water well drilling muds under various flow conditions. Details of these experiments are reported.

LASERS

REFER ALSO TO CITATION(S) 43398

43425 (AD-A—045727) **Combustion phenomena in chemical lasers. Final report, 1 May 1974—30 September 1977.** Fendall, F.E. (TRW Systems and Energy, Redondo Beach, Calif. (USA). Engi-

neering Sciences Lab.). 30 Sep 1977. Contract DAAG29-74-C-0023. 8p. NTIS PC A02/MF A01.

This final report briefly recapituates the problems studied, the results obtained, and the documents published under the subject project. Attention was focused on the modeling of 'pumping' phenomena (i.e., the formation of activated product gas HF*) in diffusion-type continuous (CW) chemical lasers of hydrogen-fluorine technology. The geometry examined was the 'basic building block' of conventional CW lasers, essentially the plane parallel mixing layer formed by coflowing steams of diatomic hydrogen and monatomic fluorine. (Aside from one task invlving the two-step symmetrical chain reaction, in which the hot slow chemical reaction and the cold fast chemical reaction were considered, only the case of high dissociarted flurine was examined). The nature of reported unsteadiness in the lasing portion of the cavity was reviewed, in order to discern whether introduction of time-averaged modeling of turbulent diffusion flames is warranted for quantitatively accurate description of pumping.

43426 (AD-A—046947) **High power laser coupling. Final report.** Hall, R.B.; Maher, W.E.; Nelson, D.J.; Nichols, D.B. (Boeing Aerospace Co., Seattle, Wash. (USA)). Jun 1977. Contract F29601-76-C-0030. 182p. NTIS PC A09/MF A01.

A photoinitiated pulsed chemical laser has been developed for laser effects studies. This laser has produced 292 J at 2.8 μm (HF) and 144 J at 3.8 μm (DF). The threshold conditions for forming absorbing plasmas at atmospheric pressure have been extensively studied for both wavelengths and for seven materials. These thresholds have been measured in terms of both irradiance and fluence requirements. After forming a laser-supported absorption wave, the resulting plasma couples energy back to the target itself. For the conditions studied, all metal targets absorb a nearly constant energy above the plasma threshold. The plasma does spread radially, however, and the resulting spatial heating profile has been measured by inverting the time-dependent temperature at r=0. These measurements largely agree with measurements of thermal coupling to several targets of varying diameter and with both HF/DF radiation. Measurements of mass loss and impulse show a threshold dependence. In addition, the specific impulse and mass loss always have a maximum value at a particular laser irradiance. at 10.6 microns (CO_2), the plasma spreading magnitude has been measured as a function of laser delivered energy. A theoretical study of target melting and vaporization indicates that efficient melt removal can occur at high intensities. This occurs because high surface temperatures lead to vaporization.

43427 (AD-A—047049) **Generation of coherent vuv and soft x-rays. Semiannual report No. 4, 1 Jan—30 Jun 77.** Harris, S.E.; Young, J.F. (Stanford Univ., Calif. (USA). Center for Materials Research). Jul 1977. Contract N00014-75-C-1175. 22p. (CMR—77-7; GL—2718). NTIS PC A02/MF A01.

The goal of the program is the development of practical sources of coherent vacuum ultraviolet radiation. During this reporting period two primary projects have been active. The first is the production of coherent radiation at the Lyman alpha wavelength of 1218 A. Such radiation is potentially applicable to the diagnosis of plasmas, such as those studied under the nuclear fusion program. The second project has elucidated the factors which limit the efficiency of the process 3547 A yields 1182 A in Xe, and suggests solutions. Details of the research are presented.

43428 (AD-A—047107) **Research in laser processes. Semiannual report 1 Aug 76—31 Jan 77.** Phelps, A.V.; Gallagher, A.C. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). 25 Jul 1977. Contract N00014-76-C-0123. 35p. NTIS PC A03/MF A01.

Numerical models of electric discharges in Na-Xe mixtures have been developed in order to examine the utility of this system for high efficiency, high power, visible lasers. Although the models are incomplete, metal vapor-rare gas discharges continue to appear promising for this application. The detailed models of the time development of the cathode fall of a high pressure discharge have been completed. Measurements and analyses of rate coefficients for electron excitation of 02 and N_2 to metastable states are being studied. Measurements have been completed of the spectral intensity of scattered light at wavelengths near the resonance line when Na vapor is illuminated by white light. The agreement with theory is good over a wide range of Na densities and added N_2 densities.

43429 (AD-A—047194) **Active Al(x)Ga(1-x)As devices for waveguide circuits. Final technical report 3 Feb 75—31 May 77.** Reisinger, A.R.; Bellavance, D.W.; Campbell, J.C.; Lawley, K.L. (Minnesota Univ., Minneapolis (USA). Dept. of Civil and Mineral Engineering). Oct 1977. Contract N00014-75-C-0501. 57p. (TI—08-77-39). NTIS PC A04/MF A01.

Etched mesa double heterojunction GaAs/GaAlAs lasers were fabricated. Evanescent field coupling into an underlying (Ga/Al)As planar waveguide was achieved with 25% coupling efficiency. Selectively grown 1-bar mesa lasers were also successfully end-fire coupled into curved grown (Ga, Al)As waveguides with 35% efficiency. Waveguide structures capable of channeling light around curves were investigated. Experiments indicate that, with current technology, an optimum radius of curvature is in the 1.27 to 2.54 mm (50 to 100 mil) range. Below 1.27 mm, radiation losses were found to increase very rapidly. (Ga, Al)As active devices compatible with monolithic laser sources were developed. A new structure design, which includes a thin (approx. 3000 A) GaAs cap, permits the fabrication of electroplated Pt Schottky barrier pads without significantly increasing the optical losses in the 8500 to 9000 A wavelength range. Electrooptic directional coupler switches were made. A 17 dB extinction ratio in the coupled channel was measured at a reverse bias voltage of -25 V. Single-line, metal-gap modulators were also demonstrated with a modulation depth of 88% at a peak voltage of -25 V. These types of devices were successfully integrated with a 90 deg curved section of an ion-milled rib waveguide with a radius of curvature of 1.016 mm (40 mils). The major source of loss was the curve itself, which accounted for 17 dB of attenuation.

43430 (AD-A—047197) **Low repetition rate copper vapor laser. Final report Jun 76—May 77.** Anderson, R.S.; Homsey, R.J.; Karras, T.W. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Sep 1977. Contract N00014-76-C-0975. 100p. NTIS PC A05/MF A01.

The program has resulted in a significant advance in the state-of-the-art. A laser module was demonstrated at a PRF of 1.0 kHz with a 12.12 mJ per pulse output, which is a factor of 7 greater than the prior art. The laser was operated consistently at a PRF as low as 700 Hz. Analysis of experimental data for a range of tube diameters and PRF values show that output pulse energy scales linearly with the active lasing volume. Significantly, no physical limit to this volumetric scaling was observed during the program. It has been concluded that a laser system for producing greater than 50 mJ per pulse is feasible using two laser modules. A brassboard design can be assembled with moderate risk using electronic components within the present state-of-the-art.

43431 (AD-A—047211) **Excimer laser research. Semi-annual report 15 Oct 76—15 Mar 77.** Parks, J.H. (Avco-Everett Research Lab., Everett, Mass. (USA)). 15 Mar 1977. Contract N00014-75-C-0063. 29p. NTIS PC A03/MF A01.

This report describes an experimental investigation of the mercury monohalides. As a class, these molecules show great promise for achieving high power scalable laser action in the visible portion of the spectrum.

43432 (AD-A—047212) **Excimer laser research. Interim technical report 15 Mar 75—Oct 76.** Parks, J.H.; Brau, C.A.; Ewing, J.J. (Avco-Everett Research Lab., Everett, Mass. (USA)). Oct 1976. Contract N00014-75-C-0063. 77p. NTIS PC A05/MF A01.

The report describes a theoretical and experimental investigation of the rare gas monohalides. As a class, these molecules show great promise for achieving high power scalable laser action in the near UV portion of the spectrum. A theory has been developed to describe the structure of these molecules. The predictions of this theory are borne out by fluorescence experiments.

43433 (AD-A—047213) **Optical conversion processes. Semi-annual report 15 Sep 76—15 Mar 77.** Trainor, D.W.; Mani, S.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 15 Mar 1977. Contract N00014-76-C-1162. 30p. NTIS PC A03/MF A01.

The overall goal of this experimental program is to identify scalable techniques that efficiently convert existing high power UV lasers to lasers operating at longer wavelengths in the visible. Two non-linear optical conversion techniques that the authors have considered are: stimulated Raman and parametric conversion involving the KrF laser (248 nm). The objective of this contract is to suggest likely acceptor atoms for each technique which will thereby allow the authors to evaluate some of the key technical issues involved. These include: the production of receptor candidates in the gas phase (typically refractory metals), the volumetric removal of the lower laser level in the stimulated Raman approach to prevent 'bottle necking' and allow recycling of the atoms during the laser pulse, and the consideration of overall system efficiency and scalability to high power.

43434 (AD-A—047214) **Optical conversion processes. Semi-annual report 15 Mar—15 Sep 77.** Trainor, D.W.; Mani, S.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 15 Sep 1977. Contract N00014-76-C-1162. 65p. NTIS PC A04/MF A01.

With the delivery and modification of an untuned high power KrF laser, experiments began on optical conversion to longer wavelengths with various candidates generated using scalable production techniques. For ease of demonstration of principle, the candidates hydrogen, iron and calcium were identified as compatible with the available power and bandwidth of our pump laser and were therefore first considered. These results demonstrate that efficient conversion of KrF towards longer wavelengths is achievable using an

untuned laser as the pump. Also, the technique of producing refractory metals in densities sufficiently high for single pass amplified spontaneous emission by the decomposition of organometallic compounds is clearly established.

43435 (AD-A—047215) **Investigation of electron impact processes relevant to visible lasers. Semi-annual report 1 Mar—31 Aug 76.** Boness, M.J.W.; Hyman, H.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 31 Aug 1976. Contract N00014-75-C-0064. 29p. NTIS PC A03/MF A01.

During this contract period construction of the electron spectrometer has been completed. The performance of the instrument has been appraised from measurements of energy loss spectra in argon and helium. Currently efforts are in progress to reduce the background signal in the instrument arising from the incident electron beam suffering inelastic collisions with various surfaces and eventually scattering into the analyzer optics.

43436 (AD-A—047216) **Investigation of electron impact processes relevant to visible lasers. Semi-annual report, 1 September 1976—28 February 1977.** Boness, M.J.W.; Hyman, H.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 28 Feb 1977. Contract N00014-75-C-0064. 41p. NTIS PC A03/MF A01.

During this contract period the noise background in the electron spectrometer has been reduced to an acceptable level. Two parallel efforts are currently underway to investigate and optimize metastable rare gas atom production. A glow discharge source has been constructed which produces on the order of $10^9/cm^3$ argon metastable atoms within the collision volume intercepted by the electron beam. Electron scattering experiments are currently underway using this source. In addition the ion current capabilities of a Duoplasmatron ion source are being explored with a view to potential application to a charge transfer source of metastable rare gas atoms. The projected metastable density achievable from such a system should be on the order of $10^{10}/cm^3$ which represents two orders of magnitude improvement over the presently employed glow discharge source.

43437 (AD-A—047217) **Small scale discharge studies. Semi-annual report Sep 74—Feb 75.** Mangano, J.A.; Jacob, J.H. (Avco-Everett Research Lab., Everett, Mass. (USA)). Feb 1975. Contract N00014-75-C-0062. 37p. NTIS PC A03/MF A01.

The report has investigates the possibility of building high power visible and uv lasers. A likely method of scaling visible lasers to high average powers is by e-beam controlled discharges. The discharge physics of Ar/N_2, N_2/NO and SF_6/N_2 mixtures has been investigated. These laser mixtures were chosen because they effectively cover the wide variety of discharge conditions one is apt to encounter.

43438 (AD-A—047218) **Small scale discharge studies. Semi-annual report 1 Mar—31 Aug 75.** Jacob, J.H.; Mangano, J.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 31 Aug 1975. Contract N00014-75-C-0062. 41p. NTIS PC A03/MF A01.

Laser action has been obtained in atmospheric-pressure mixtures containing approx. 95% Ar approx. 5% Kr and $<$ or $=$ 0.3% F_2 by e-beam controlled discharge pumping. The physics of these discharges are dominated by electron impact excitation and ionization of the rare gas metastables. The ionization of the metastables impacts the discharge stability directly while their excitation strongly effects the efficiency of producing KrF*. Hence, two step ionization is dominant. For stable equilibrium, the attachment rate has to be greater than or equal to twice the ionization rate. Under stable discharge conditions, the metastable production efficiency can be as high as 70% and the KrF* production efficiency 35%.

43439 (AD-A—047219) **Small scale discharge studies. Semi-annual report 1 Sep 75—29 Feb 76.** Jacob, J.H.; Mangano, J.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 29 Feb 1976. Contract N00014-75-C-0062. 59p. NTIS PC A04/MF A01.

The report describe the modelling of an e-beam controlled discharge operated in gas mixtures containing mainly argon with approximately 10% krypton and a few tenths of a percent fluoride. The discharge physics is dominated by electron impact ionization and excitation of the rare gas metastables. The ionization of the metastables impacts the discharge stability directly while their excitation strongly effects the efficiency of producing KrF*. Two step ionization is dominant and a stability criterion is developed for these discharges. Predictions of the model are compared with experimental results.

43440 (AD-A—047220) **Small scale discharge studies. Semi-annual report 1 Mar—31 Aug 76.** Jacob, J.H.; Mangano, J.A.; Rokni, M. (Avco-Everett Research Lab., Everett, Mass. (USA)). 31 Aug 1976. Contract N00014-75-C-0062. 43p. NTIS PC A03/MF A01.

The report discusses the discharge physics and the formation and quenching processes in typical XeF laser mixtures. The discharge physics is dominated by electron impact excitation and ionization of the rare gas metastables. The ionization of the metastables impacts the discharge stability directly while their excitation strongly affects the efficiency of producing XeF*. Discharge experiments determined that Xe (6p) states react with NFt^3 to produce XeF* with a branching ratio of 0.7. The rate constant for this reaction is .0004 cm^3/sec. The formation and quenching processes have been determined by analyzing the dependence of (B2 Sigma(+)1/2 goes to X2 Sigma(+)1/2 radiation on the partial pressures of Ar, Xe, and F_2. In the experiments the XeF* was produced by a high energy e-beam. We have determined the two and three body quenching rates by Ar to be $8 +- 4x10^{-13}$ cc/sec and $1.5 +- 0.5 \times 10^{-32}$ cm to the 6th/sec. Xe quenches XeF* with a three body rate of $3 +- 1.5 \times 10$ to the -31st cm to the 6th/sec; the third body was mainly argon. (Author)

43441 (AD-A—047221) **Small scale discharge studies. Semi-annual report 1 Sep 76—28 Feb 77.** Rokni, M.; Jacob, J.H.; Mangano, J.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 28 Feb 1977. Contract N00014-75-C-0062. 68p. NTIS PC A04/MF A01.

The dominant formation and quenching processes in e-beam pumped ArF* and KrF* lasers are discussed. The exciplexes are produced by irradiating Ar/F_2 and $Ar/Kr/F_2$ mixtures with a 5 A/cm^2, 150 keV e-beam. A steady state analysis is valid since the reaction times are short compared to the 300 nsec beam pulse length. The quenching of ArF* by F_2 and Ar has been measured by analyzing the ArF* fluorescence as a function of the F_2 and Ar partial pressures. The displacement of the Ar in ArF* by Kr to form KrF* was measured. The dominant quenching processes of KrF* were identified and the rate constants were measured. The ArF* and KrF* are formed from the ionic states with high efficiency. Interception of the precursers can be made negligible by choosing the experimental conditions properly. The quenching of KrF* by Ar and Kr is mainly a three body process resulting in the formation of Kr_2F^*. The emission from Krt^2F^* was observed in a broad band centered at 410 nm. The Kr_2F^* is produced subsequent to the KrF* formation.

43442 (AD-A—047407) **DARPA—NRL Laser Program: semiannual technical report to Defense Advanced Research Projects Agency. 1 October 1976—30 March 1977. Interim report.** (Naval Research Lab., Washington, D.C. (USA)). Sep 1977. 84p. (NRL-MR—3580). NTIS PC A05/MF A01.

The DARPA-NRL Laser Program is concerned with the development of laser technology of electronic state lasers and associated physics. In particular the development of the XeF laser has been emphasized. Experimental and theoretical efforts were made to understand and improve laser performance. The radiative lifetime of XeF was measured by photolytic dissociation of XeF_2. A short pulse electron beam device was set up to remeasure the XeF lifetime more accurately and work was started to synthesize KrF_2 in order to measure the lifetime of KrF. Values for the radiative lifetime are used in a code to predict laser performance of both XeF and KrF. Experimentally the performance of the XeF laser has been improved. Long laser pulses were observed for the first time and laser efficiency was increased by substitution of Ne for Ar, the diluent. Absorption measurements combined with code calculations showed that the improvement was due to decreased dimer ion optical absorption.

43443 (AD-A—047628) **Manufacturing methods and technology engineering for neodymium doped YAG laser rods. Quarterly progress report No. 1, 1 Mar—31 May 77.** Dentz, D.; Lowe, I.; Turner, S.; Belt, R. (Litton Systems, Inc., Morris Plains, N.J. (USA). Airtron Div.). Jun 1977. Contract DAAB07-77-C-0375. 18p. NTIS PC A02/MF A01.

The planning of the effort and initial work on the batch fabrication of Nd:YAG laser rods were accomplished. The primary objectives of the work were to complete design of the polishing fixture and select an initial manufacturing process. The polishing fixture designed is capable of holding sixteen laser rods within the required tolerances during the grinding and polishing process. The polishing process selected, based upon prior work, consists of three separate grinding steps and two polishing steps. All work is to be accomplished at a single work station.

43444 (AD-A—047632) **Preliminary analysis of the performance of the University of Rochester's glass development laser. Technical information series.** Burnham, G.T. (General Electric Co., Syracuse, N.Y. (USA). Heavy Military Equipment Dept.). Oct 1977. 29p. (R—77EMH12). NTIS PC A03/MF A01.

The results of a three-dimensional computer code analysis of the University of Rochester's Glass Development Laser through the 90-mm diameter rod amplifier stage is presented. Through the use of re-imaging optics (via vacuum spatial filtering) system outputs as well as performance prediction capabilities are considerably improved.

43445 (AD-A—047684) **One meter KRF laser system. Semi-annual report 23 Aug 76-22 Feb 77.** Hsia, J.C.; Jacob, J.H.; Mangano, J.A.; Rokni, M. (Avco-Everett Research Lab., Everett, Mass. (USA)). 22 Feb 1977. Contract N00014-76-C-1032. 93p. NTIS PC A05/MF A01.

This interim report covers research directed towards electron beam and electron beam sustained discharge pumping of rare gas-halide lasers. The key issues being addressed are: (1) upper laser level formation and quenching, (2) laser medium gain and absorption, (3) laser energy extraction, (4) kinetic modeling, (5) attainable laser efficiency and energy scaling, and (6) spatial uniformity in excitation. Using a magnetically guided E-beam to pump a KrF laser, 102 joules of laser output was obtained in an active laser volume of 8.5 liters with 9% intrinsic laser efficiency. Laser performance agree with predictions of the kinetic model over the range of operating conditions investigated.

43446 (AD-A—047685) **Investigation of electron impact processes relevant to visible lasers. Semi-annual report 1 Mar—31 Aug 77.** Boness, M.J.W.; Hyman, H.A. (Avco-Everett Research Lab., Everett, Mass. (USA)). 31 Aug 1977. Contract N00014-75-C-0064. 53p. NTIS PC A04/MF A01.

The emphasis of the work during the reporting period has been placed upon the design and optimization of a glow discharge source of metastable atoms which was subsequently installed in the electron spectrometer system. As a consequence of signal-to-noise problems and long term stability limitations encountered with the energy loss spectroscopy the experiment has been modified and a fluorescence diagnostic substituted for the electrostatic electron energy analyzer. Preliminary experiments involving electron-ground state atoms have been performed in order to evaluate the sensitivity of the fluorescence technique. Numerous experimental modifications have been performed in order to reduce the principal source of noise, namely fluorescence emission from the discharge source.

43447 (AD-A—047746) **High power short wavelength laser development. Final technical report 1 Jul 76—30 Sep 77.** Cohn, D.B.; Lacina, W.B. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Nov 1977. Contract N00014-76-C-1100. 173p. (NRTC—77-43R). NTIS PC A08/MF A01.

Results of a comprehensive experimental and theoretical investigation of a large volume, electron beam and discharge excited KrF laser are reported. For pulse lengths approx. 1 microsec, maximum specific energy extraction was 22 J/liter at 10% efficiency and maximum total energy was 90J for a 10 liter gain volume. Discharge enhancement of output energy was limited by discharge instability as a result of beam deposition nonuniformity. Excellent agreement in terms of absolute values and waveforms was obtained with an extensive computer code.

43448 (AD-A—048225) **Tunable lasers and coherent light techniques for high resolution ultraviolet spectroscopy. Technical report No. 6, 1 Jan—31 Dec 77.** Haensch, T.W. (Stanford Univ., Calif. (USA). Edward L. Ginzton Lab.). Dec 1977. Contract N00014-75-C-0841. 31p. (GL—2758). NTIS PC A03/MF A01.

The report summarizes recent efforts towards the development, improvement, and use of tunable laser systems and novel coherent light techniques for high resolution ultraviolet spectroscopy of atoms and molecules. It reports on: (a) studies of atomic hydrogen and deuterium by Doppler-free ultraviolet laser spectroscopy, which have yielded new precision values of the 1S-2S isotope shift and of the 1S ground state Lamb shift; (b) the first demonstration of a novel technique of high resolution laser spectroscopy, using coherent two-photon excitation with multiple light pulses; (c) the status of a search for a hydrogen-laser-pumped tunable ultraviolet laser; and (d) the observation of a quenching of the laser action in xenon fluoride excimer lasers by the vapor of xenon difluoride.

43449 (AD-D—004395) **Rf excited mercury laser lamp.** Siegman, A.E. (Department of the Air Force, Washington, D.C. (USA)). 1977. 14p. NTIS PC02/MF A01.

An optically pumped laser is described wherein the optical pumping is provided by a mercury discharge lamp and a radio-frequency excited coil surrounding the lamp. The discharge lamp is constructed in the form of a closed loop and is inductively excited by the high power radio-frequency coil. The coil forms the primary coil and the lamp the secondary coil of an air-core transformer. Current in the lamp is excited entirely by the radio frequency magnetic fields passing through the plane of the lamp thereby optically pumping the lasing medium.

43450 (COO—2007-93) **Progress in nuclear pumped lasers.** Boody, F.P.; Prelas, M.A.; Nagalingam, S.J.S.; Miley, G.H. (Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering). 1978. Contract EY-S-02-2007. 5p. (CONF-780135—2). Dep. NTIS, PC A02/MF A01.

From 3. NASA conference on radiation energy conversion; Moffett Field, CA, USA (26 Jan 1978).

A brief review of the historical development of nuclear pumped lasers is given. The sources available for nuclear pumping of gas lasers are mentioned. Some experimental results are briefly described.

43451 (COO—2922-2) **Visible laser discharge studies. Quarterly progress report, March 1, 1977—May 31, 1977.** Srivastava, B.N.; Jacob, J.H.; Mangano, J.A.; Hsia, J.C. (Avco-Everett Research Lab., Everett, Mass. (USA)). 1977. Contract EY-76-C-02-2922. 18p. Dep. NTIS, PC A02/MF A01.

Research progress is reported on an effort to develop a numerical model for the plasma return current discharge for a wide range of discharge conditions likely to be encountered in making visible lasers. The resulting model will be used to calculate the temporal variation of the electric field and secondary electron density as a function of the following parameters: (1) e-beam current density; (2) gas composition; and (3) gas pressure.

43452 (COO—4080-4) **Development of improved laser glasses which can be melted on a commercial scale. Annual progress report, September 15, 1976—September 30, 1977.** Rapp, C.F.; Huff, N.T.; Vergano, P.J. (Owens-Illinois, Inc., Toledo, Ohio (USA)). Apr 1978. Contract EY-76-C-02-4080. 160p. Dep. NTIS, PC A08/MF A01.

Large neodymium doped glass laser systems are presently being built for nuclear fusion research. However, the power which can be generated by these systems is generally limited by self focusing in the laser glass. This study was undertaken to develop laser glasses with a minimum nonlinear refractive index which would allow the generation of higher powers in these laser systems. Various fluorophosphate glass forming systems were investigated in order to develop laser glasses with "optimum" properties (low n_2, medium sigma, long tau, highly stable). In these fluorophosphate systems, the regions of glass formation were defined and glass composition-property correlation equations were derived which related the various properties (n/sub D/, n_2, sigma, the Nd^{3+} peak lambda, Δlambda, effective Δlambda, sigma and tau radiative) to the glass composition. Specific glass compositions were developed which had nonlinear refractive indices of about $^1/_3$ those of commercial silicate laser glasses but had comparable spectroscopic properties (i.e., sigma). These glasses were sufficiently stable to cast single pieces of glass weighing in excess of 50 lbs.

43453 (N—77-31963) **Fission induced plasmas. Progress report, 15 December 1976—30 June 1977 1977.** Harries, W.L. (Old Dominion Univ., Norfolk, Va. (USA). Research Foundation). Sep 1977. 21p. (NASA-CR—154894). NTIS PC A02/MF A01.

The possibility of creating a plasma from fission fragments was investigated, as well as the probability of utilizing the energy of these particles to create population inversion leading to laser action. Eventually, it is hoped that the same medium could be used for both fissioning and lasing, thus inefficiences in converting one form of energy to the other will be avoided. A central problem in understanding a fission induced plasma is to obtain an accurate model of the electron behavior; some calculations are presented to this end. The calculations are simple, and provide a compendium of processes for reference.

43454 (NTIS/PS—77/1107) **Carbon monoxide lasers (citations from the NTIS data base). Report for 1964-Dec 77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 194p. NTIS PC N01/MF N01.

The abstracts of Federally-funded research reports cover gas discharge, gas dynamics, electron beam, and infrared and chemical lasers involving carbon monoxide as a lasing medium. Molecular excitation, energy transfer, and reaction kinetics are discussed. Studies on laser pumping are included. The updated bibliography contains 189 abstracts, 25 of which are new entries to the previous edition.

43455 (NTIS/PS—77/1108) **Carbon monoxide lasers (citations from the engineering index data base). Report for 1970-Dec 77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 200p. NTIS PC N01/MF N01.

Worldwide research on carbon monoxide laser excitation, plasmas, development, equipment, optics, transitions, and gas mixtures are cited. Studies on optical pumping, laser spectroscopy, gas dynamics, chemical reactions, and performance tests are included. The updated bibliography contains 193 abstracts, 34 of which are new entries to the previous edition.

43456 (NTIS/PS—77/1167) **Hydrogen fluoride and deuterium fluoride lasers. Volume 1. 1964—1975 (a bibliography with abstracts). Report for 1964—75.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 206p. NTIS PC N01/MF N01.

The bibliography cites research on the design, development, theories, and kinetics of these chemical lasers. Studies on laser materials for gas dynamics, molecular interactions, chemical reac-

tions, energy transfer, optics, and performance are included. (This updated bibliography contains 201 abstracts, none of which are new entries to the previous edition.)

43457 (NTIS/PS—77/1168) **Hydrogen fluoride and deuterium fluoride lasers. Volume 2. 1976—1977 (a bibliography with abstracts). Report for 1976—1977.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 111p. NTIS PC N01/MF N01.

The chemical reactions, molecular interactions, kinetics, and quantum mechanics in hydrogen fluoride and deuterium fluoride laser development are cited. Studies on excitation, optical equipment, gas mixtures and window materials for these lasers are included. The spectral output, power, efficiency, applications, and performance of HF and DF lasers are also covered. (This updated bibliography contains 106 abstracts, 59 of which are new entries to the previous edition.)

43458 (NTIS/PS—77/1176) **Gallium arsenide lasers (a bibliography with abstracts). Report for 1964-77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 167p. NTIS PC N01/MF N01.

The report covers the design, development, and applications of gallium arsenide lasers. Studies on band theory, optical modulators, emission spectra, optical pumping, tuning, and efficiency of these lasers are included. (This updated bibliography contains 162 abstracts, 38 of which are new entries to the previous edition.)

43459 (NTIS/PS—78/0003) **Ultraviolet lasers (a bibliography with abstracts). Report for 1966-77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 177p. NTIS PC N01/MF N01.

Government-sponsored research on the design, development, theory, and diagnostics of ultraviolet lasers is cited. Studies on molecular reactions, electron transitions, excitation, tuning, and optical pumping of these systems are covered. Materials lasing in these wavelengths and optical equipment for these lasers are also included. The updated bibliography contains 172 abstracts, 47 of which are new entries to the previous edition.

43460 (NTIS/PS—78/0004) **X-ray lasers (a bibliography with abstracts). Report for 1969-77.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 87p. NTIS PC N01/MF N01.

Citations of Federally-funded research on the theory, design, development, testing and output of X-ray lasers are presented. Studies on sources, excitation, amplification, pumping, tuning, and optimization of these lasers is included. The updated bibliography contains 82 abstracts, 23 of which are new entries to the previous edition.

43461 (TID—28427) **Theoretical investigation and calculation of certain atomic and molecular processes important in the formation and destruction of excited stable gas molecules (or excimers). Technical progress report, October 1, 1976—September 30, 1977.** Flannery, M.R. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1977. Contract EY-76-S-05-5002. 95p. Dep. NTIS, MF A01.

Portions of document are illegible.

The overall aim of this research program is to delineate the atomic and molecular processes in the formation and destruction of various systems which act as current or potential laser candidates required for laser fusion. Research progress is reported on: (1) cross sections for photoionization and electron impact ionization of metastable rare-gas atoms were formulated and calculated as a function of photon-wavelength and of electron-energy respectively; (2) theoretical treatments of ion-ion recombination were developed and applied to various processes involving rare-gas atomic ions combining with negative fluorine ions in the presence of a neutral rare-gas at high pressures; and (3) various studies of collisions involving atoms initially in excited states were initiated and certain new important systematic trends were observed.

43462 (UCRL—52411) **User's guide to designing and mounting lenses and mirrors.** Kowalskie, B.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Feb 1978. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

The guidebook is a practitioner-oriented supplement to standard texts in optics and mechanical engineering. It reflects practical experience with the oftentimes troublesome aspects of effectively integrating optical components with mechanical hardware. Accordingly, its focus is on the techniques, assumptions, and levels of design sophistication needed for a wide variety of sizes and optical surface quality levels. It is intended to be a primer for engineers, designers, and draftsmen already familiar with some of the problems encountered in mounting optical components and who are responsible for developing components for high-energy laser systems.

43463 Gaseous laser device with damage-resistant cathode. Fein, M.F.; Salisbury, C.W. (to Owens-Illinois, Inc.). US Patent 4,085,385. 18 Apr 1978. Filed date 21 Mar 1975. 24p.

A gaseous laser device with a novel damage-resistant cathode geometry is described. The device comprises an envelope, a cathode volume having at least one wall, an electrically conductive cathode within the cathode volume, a lasing gaseous volume, and an anode. The cathode comprises an electrically conductive material supported by at least one cathode wall with at least one cathode wall edge being vulnerable to gas discharge deterioration. The gas discharge erosion of at least a portion of the vulnerable cathode edge is substantially prevented by the positioning of a juxtaposed protective cover plate over the cathode edge.

43464 Independent initiation technique of glow discharge production in high-pressure gas laser cavities. Farish, O.; Hundstad, R.L. (to Westinghouse Electric Corp.). US Patent 4,085,386. 18 Apr 1978. Filed date 9 Mar 1976. 6p.

A trigger circuit which operates independently of the main discharge circuit can be used to initiate glow discharge useful for gas laser excitation. By utilizing independent trigger means, such as auxiliary dielectric electrodes, the main discharge can be controlled by modulating only a small part of the total energy input to the laser cavity. The main discharge gap of the laser is prestressed to a voltage below the spark breakdown voltage threshold of the electrode assembly under static conditions but above the glow discharge voltage of the electrode assembly. When the trigger means is pulsed to supply free electrons to the discharge gap the glow discharge is initiated between the electrodes independent of the need for modulating the main power to the gap.

43465 Laser for integrated optical circuits. Holton, W.C. (to Texas Instruments Inc.). US Patent 4,084,130. 11 Apr 1978. Filed date 11 Jun 1976. 16p.

A description is given of a semiconductor laser of electrically pumped type comprising a substrate of III-V compound semiconductor material or mixed ternary III-V semiconductor composition having a mesa structure provided with a p-n junction between regions of opposite conductivity therein. An electrical power source is connected to the mesa and upon activation causes the injection of minority carriers across the p-n junction, such that laser radiation is produced from the p-n junction.

43466 CO_2 laser. Rink, J.P. (to Energy Research and Development Administration). US Patent 4,063,190. 13 Dec 1977. Filed date 30 Dec 1975. 4p.

PAT-APPL-645,168.

A pulsed gas laser is described comprising an optical resonant cavity, a CO_2 lasing medium, structure for containing the CO_2 lasing medium within the optical cavity and a device for causing a population inversion in the lasing medium, with a novel improvement comprising structure for causing a laser pulse comprising a wavelength in the near 14 μm and near 16 μm range. The structure for cooling the CO_2 lasing medium to less than about -40° C as well is a structure for pumping the maximum inversion of CO_2 molecules within the lasing medium by minimizing the population in the 010 level.

43467 Solid state blue-green laser with high efficiency laser pump. Nicolai, V.O. US Patent 4,054,852. 18 Oct 1977. Filed date 28 Jul 1976. 4p.

A high efficiency, high power blue-green laser is described which is capable of providing short pulses useful for underwater communication and detection systems. To provide the desired blue-green lasing, a solid state laser is pumped by a matched high-efficiency laser having relatively long duration output pulses. Q-switching of the solid state laser is used to shorten the duration and increase the peak power of the pulses. Material found especially useful for practice of the invention are Holmium (+3) and Praseodymium(+3) as the solid state laser and a dye laser pumped by a mercury capillary lamp as the pumping laser. (Author)

43468 Stark-tuned laser modulator. Asawa, C.K.; Plant, T.K. (to Hughes Aircraft Co.). US Patent 4,085,387. 18 Aug 1976. Filed date 18 Apr 1978. 6p.

Apparatus is disclosed for modulating the R(18) or the R(24) lines of the ($00^0$1 to $10^0$0) vibrational band of a $C^{13}O_2{}^{16}$ laser using Stark-tuned absorption resonances in $N^{14}H_3$. A dc electric field is applied to a Stark cell containing $N^{14}H_3$ gas to tune the asQ(6,6) absorbing transition in $N^{14}H_3$ so as to overlap the R(1.8) laser line or the asQ(2,2) transition so as to overlap the R(24) line. Modulating frequencies approaching 300 MHz can be employed, and a 100% modulation depth is achievable with audio modulating frequencies. Unsaturated modulation was obtained using a Stark cell of 10 cm length and containing $N^{14}H_3$ gas at a pressure of 0.45 torr for a laser power density of 12 watts per cm^2.

43469 High-efficiency high-power lasers. Watanabe, S.; Kashiwagi, H. (Electrotechnical Lab., Tokyo (Japan)). *Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku;* No. 187, 1-50(Jun 1976).

The review report on high efficiency, high power laser is presented. The large systems of Nd glass and CO_2 lasers with the power output from 1 to 10 KJ are now under construction for the breakeven experiments at the Lawrence Livermor Laboratory, Los Alamos Scientific Laboratory and others. However, these lasers have limitations on their application to laser-induced nuclear fusion because of their low efficiency and long wavelength. In Chapter 2 of this report, the basic parameters of the Nd glass, CO_2, iodine and HF lasers are summarized. Since it is required that the stimulated emission cross section is as small as 10^{-18} to $10^{-20}cm^2$ for large stored energy, the transition with large line width is recommended for a scalable high power laser. Large line width is suitable for the generation of short pulses. In chapter 3, the efficiency of existing high-power lasers is analyzed. It is confirmed that a high-pressure, large-volume gas laser is the most promising as a high-efficiency and high-power one. In chapter 4, four kinds of excimer lasers are reviewed. Rare-gas halide excimer lasers are the most promising among the four. In conclusion, it is said that the scaling up of the systems and the shortening of pulse width in KrF excimer laser and high efficiency HF laser are important as well as the identification of new media with high efficiency, high power and suitable wavelength.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 42739, 42812, 42865, 43149, 43291

43470 (CONF-771204—3) **Numerical calculation of transonic flow past a swept wing by a finite volume method.** Jameson, A. (New York Univ., N.Y. (USA). Courant Inst. of Mathematical Sciences). 1977. Contract EY-76-C-02-3077. 25p. Dep. NTIS, PC A02/MF A01.

From 3. international symposium on computing methods in applied sciences and engineering; Versailles, France (5 Dec 1977).

The finite volume method for the numerical calculation of transonic flow past a swept wing was developed and its use for calculating the pressure distribution on the upper surface of a Onera m6 wing in Mach No. 0.84 flow and of a Douglas DC10 wing in M = 0.85 flow is illustrated. Calculated results are compared with experimental data. The results confirm the promise of the new method. It appears that it can be used to treat configurations of more or less arbitrary complexity, subject to limits set by the power of the available computers. The extension to new configurations is primarily a matter of devising mesh generating schemes, since the internal computations are essentially independent of the configuration, apart from the identification of which elements are the boundary elements. (LCL)

43471 (ESDU—77016) **Gravitational component of pressure gradient for two-phase gas or vapour/liquid flow through straight pipes. Data item.** (Engineering Sciences Data Unit Ltd., London (UK)). Aug 1977. 61p. For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161.

This Item predicts the gravitational component of pressure gradient from an assessment of seven separate prediction methods. From these seven, the best for particular circumstances can be quickly identified using specially prepared Method Selection Charts. Several Performance Charts have also been prepared: these present statistically derived correction factors that enable the predictions of each method to be aligned with a wide range of experimental data. Besides these seven prediction methods, which have been assessed for both vertically-upwards flowing mixtures in general and also separately for the important case of vertically-upwards flowing saturated steam/water mixtures, a conversion method is included to allow the gravitational component of pressure gradient to be calculated in both uphill and downhill inclined flows.

43472 Analytical study of the thermally induced two-phase flow instabilities including the effect of thermal non-equilibrium. Saha, P.; Zuber, N. (Georgia Inst. of Tech., Atlanta). *Int. J. Heat Mass Transfer;* **21**: No. 4, 415-426(Apr 1978).

The problem of thermally induced flow instabilities in a uniformly heated boiling channel was studied analytically. The effect of thermal non-equilibrium between the phases was included by deriving a constitutive equation for the mass rate of vapor generation from steady state energy consideration. The system characteristic equation is derived by introducing a small perturbation in the inlet velocity, and the system stability boundary is determined by using the D-partition method. When compared with the equilibrium theory, the present non-equilibrium theory predicts a more stable system at low subcooling number and a more unstable system at high subcooling number. When compared with experiment, the present non-equilibrium theory agrees well with the data on the system stability boundary at low subcooling and the frequency of oscillations. However, further studies are required for better prediction of the system stability at high subcooling.

43473 Thermodynamic approach to qualitative properties of trajectories of heat and mass transfer in gas—solid flow systems. I. Nonreacting systems. Sieniutycz, S.; Komorowska-Kulik, J. (Warsaw Technical Univ.). *Int. J. Heat Mass Transfer;* **21**: No. 4, 489-497(Apr 1978).

A study is presented of the qualitative properties and stability of trajectories of simultaneous heat- and mass-transfer processes in gas—solid flow systems. Liapunov functions based on the thermodynamic principle are constructed, and the instability of trajectories of counter flow processes is thermodynamically grounded. Emphasis is placed on the general character of the thermodynamic approach to the stability and qualitative properties of trajectories.

43474 Electroconductivity technique for the measurement of axial variation of holdups in three-phase fluidized beds. Begovich, J.M.; Watson, J.S. (Oak Ridge National Lab., TN). *AIChE J.;* **24**: No. 2, 351-354(Mar 1978).

An electroconductivity technique is described which can be used not only for determining the overall phase holdups in a three-phase fluidized bed, but, more importantly, it can also be used for determining the local holdups as a function of height in the column. One disadvantage of the technique is that it can only be applied to systems with electroconductive liquids. However, since most real or prototype systems use either water or can be simulated with a fluid that can readily be made electroconductive, this handicap does not seem to be too severe. The technique has been applied successfully to a number of systems, including porous alumina beads, if a correction is made for their internal porosity. It has shown the existence of the transition region as the bed goes from a three-phase to a two-phase system. Further work should result in correlations for the distribution of the three phases throughout the entire column. These predictive equations will help in the rational design of reactors in which local conditions throughout the bed must be considered.

43475 Two-phase flow in helical coils: flow pattern, pressure drop, and holdup. Reddy, C.J.M.; Satyanarayan, A. (Regional Engineering Coll., Warangal, India). *J. Inst. Eng. (India), Chem. Eng. Div.;* **58**: 10-17(Oct 1977).

The flow pattern, frictional pressure drop and holdup of an air-water two-phase flow in helically coiled tubes are presented. The effects of tube diameter and coil diameter on flow pattern pressure drop and holdup for cocurrent air-water flow in coiled tubes was investigated. The effect of helix angle on pressure drop was also investigated. The experiments were conducted in the range of superficial water velocity 15.2 to 69 cm/sec and superficial air velocity 127.5 to 1,530 cm/sec. Attention was mainly focussed on slug, slug-annular and annular flow pattern. Both pressure drop and holdup could be adequately correlated using Lockhart-Martinelli approach. Four types of empirical equations for the frictional pressure drop are proposed.

43476 Low to high temperature energy conversion system. Miller, C.G. (to National Aeronautics and Space Administration). US Patent 4,044,821. 30 Aug 1977. Filed date 27 Dec 1974. 9p.

A method for converting heat energy from low temperature heat sources to higher temperature was developed. It consists of a decomposition chamber in which ammonia is decomposed into hydrogen and nitrogen by absorbing heat of decomposition from a low temperature energy source. A recombination reaction then takes place which increases the temperature of a fluid significantly. The system is of use for the efficient operation of compact or low capital investment turbine driven electrical generators, or in other applications, to enable chemical reactions that have a critical lower temperature to be used. The system also recovers heat energy from low temperature heat sources, such as solar collectors or geothermal sources, and converts it to high temperatures.

43477 Shallow fluidised-bed heat transfers. Al Ali, M.A.; Broughton, J. *Appl. Energy;* **3**: 101-114(Apr 1977).

Shallow fluidised-beds have great potential as heat exchangers, since the pressure drop is low enough not to require the use of large fans. An investigation of shallow-bed heat transfer is reported and observations are compared with established deep-bed experience. The prediction of the fluidising velocity at which the heat transfer coefficient maximum is obtained is considered in some detail. A simple hypothesis based upon the two-phase theory of fluidisation is proposed as an alternative to the present inaccurate empirical approach.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 42623, 43244

43478 (NTIS/PS—78/0014) **Nondestructive testing of pavements and pavement bases. (a bibliography with abstracts). Report for 1964-Jan 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, Va. (USA)). Jan 1978. 119p. NTIS PC N01/MF N01.

Nondestructive methods for quality assurance of pavements and pavement bases are investigated in these Government-sponsored research reports. Vibration, nuclear activation, radiometry, and acoustic detection are among the various techniques employed. The updated bibliography contains 114 abstracts, 17 of which are new entries to the previous edition.

43479 (SAND—77-0606) **Equations of motion for free-flight systems of rotating-translating bodies having variable mass and configuration.** Hodapp, A.E. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

General vector differential equations of motion are developed for a system of rotating-translating, unbalanced, variable mass, variable configuration bodies. Complete flexibility is provided in placement of the reference coordinates within the system of bodies and in placement of body fixed axes within each body. Examples are presented to demonstrate the ease with which these equations can be reduced to the equations of motion for systems of interest.

43480 (UCRL—50016-77-4, pp 13-21) **Variabilities detected by acoustic emission from filament-wound aramid fiber/epoxy composite pressure vessels.** 31 Dec 1977.

In Mechanical Engineering Department quarterly report, October—December 1977.

Research progress on the acoustic emission technique to proof test 30 filament-wound Kevlar-epoxy pressure vessels is reported. Results demonstrate the wide applicability of acoustic emission for identifying the significant process-control problems in the manufacture of fiber composites.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 43525

43481 (SAND—77-0702J) **Multiple fault analysis in synchronous sequential circuits by means of vector Boolean difference.** Goldstein, L.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 4p. (CONF-770891—1). Dep. NTIS, PC A02/MF A01.

From 20. symposium on circuits and systems; Albuquerque, NM, USA (15 Aug 1977).

The Boolean difference is an elegant mathematical concept which has found significant application in the study of single faults of a stuck-at nature in combinational logic circuits. Recently, several authors have extended this technique to the analysis of multiple faults in combinational circuits. The concept of vector Boolean difference is further extended to the analysis of multiple stuck-at faults in synchronous sequential circuits.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 43209, 43210

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 42207, 42209, 42211, 42642, 43232

43482 (FE—2471-6) **Industrial application fluidized bed combustion. Category III. Indirect fluid heaters. Quarterly technical report No. 2, October 1—December 31, 1976.** Cherrington, D.C.; Golan, L.P.; Halow, J.S.; Hammitt, F.G. (Exxon Research and Engineering Co., Florham Park, N.J. (USA). Engineering Technology Dept.). 26 Jan 1977. Contract EX-76-C-01-2471. 27p. Dep. NTIS, PC A03/MF A01.

A program has been initiated to evaluate the technical and economic potential for the application of fluidized bed combustion technology to refinery and petrochemical plant indirect fired process heaters. The strategy for the program will be to build on the available boiler orientated FBC technology. The two pertinent areas that are not being addressed in the on-going boiler orientated programs and which will be investigated here concern the effects of larger tube size and hydrocarbon coking. Phase I of the program will consist of three laboratory experiments designed to generate data on (a) the effect of tube size and arrangement on bed fluidization, (b) relationships between heat flux and tube coking rate and (c) tube peripheral flux maldistribution in a fluidized bed. Based on these data, a technical and economic evaluation of the commercial potential for this technology will be made. If favorable, Phase II will provide for the design, fabrication and operation of a 10-15 MBtu/hr demonstration FBC process heater in an actual refinery complex. Program effort has been directed toward the planning and design of the first two of the three laboratory units. These are (1) a Two-Dimensional Flow Visualization Unit for studying fluidized bed behavior in the presence of relatively large diameter immersed tubes and (2) a Process Stream Coking Unit to evaluate the parameters affecting coking rate for a hydrocarbon stream exposed to high flux rates of the level encountered in fluidized bed combustion. Design of both units is essentially completed, material and equipment components are on order and construction of the Two-Dimensional Flow Visualization Unit is underway.

43483 (FE—2471-14) **Industrial application fluidized bed combustion. Category III. Indirect fired heaters. Monthly technical report No. 10, August 1—31, 1977.** Cherrington, D.C. (Exxon Research and Engineering Co., Florham Park, N.J. (USA). Engineering Technology Dept.). 15 Sep 1977. Contract EX-76-C-01-2471. 11p. Dep. NTIS, PC A02/MF A01.

Testing of two additional bundle configurations has been completed on the Two-Dimensional Flow Visualization Test Unit. These were the bundles made up of 6-inch diameter tubes on 3 diameter spacing and 6-inch diameter tubes on 2 diameter spacing. In general, the data indicate that peripheral maldistribution of flux is poorer with the tighter tube spacing. During September, a 6-inch diameter tube bundle on 4 diameter spacing will be evaluated and some single tube data will be obtained. The Process Stream Coking Unit was moved into the Bayway Refinery and reassembled at the test site. Tie-ins to the Refinery crude and utility lines are being made. Prestartup checkout of the unit and operator training will be initiated during September. Additional conductive/convective heat transfer data have been obtained on each of the bundle configurations tested in the Two-Dimensional Flow Visualization Tests.

43484 (FE—2471-19) **Industrial application fluidized bed combustion. Category III. Indirect fired heaters. Monthly technical report No. 12, January 1—31, 1978.** Cherrington, D.C. (Exxon Research and Engineering Co., Florham Park, N.J. (USA). Engineering Technology Dept.). 1978. Contract EX-76-C-01-2471. 14p. Dep. NTIS, PC A02/MF A01.

A total of six bundle configurations have been evaluated in the Two-Dimensional Flow Visualization Test Unit. Based on the results of these tests, a bundle made up of 4-inch diameter tubes on 2-diameter tube center-to-center spacing and equilateral triangular pitch has been selected for installation in the "hot" Heat Flux Test Unit. The remaining test work planned for this task of the program consists of evaluating the effects of operating with alternative bed particle size distribution and of moving the tube bundle closer to the distribution grid. Startup activities continued on the Process Stream Coking Unit. The gas fired crude preheater was successfully dried out and preliminary calibration runs were made on the electric heaters. Several instrument failures made it necessary to return some equipment to suppliers for component replacement. Some equipment additions and changes were also required as a result of potential problems identified during commissioning activities. Orders have been placed for the Heat Flux Test Unit and associated air fin cooler. Detailed design and procurement activities on other equipment items are underway. The first of several planned design progress review meetings was held with the supplier of the Heat Flux Test Unit.

43485 Apparatus for detecting non-combusted fuel components in exhaust gases of a heating installation and method for operating the aforesaid apparatus. Hunziker, R. US Patent 4,078,880. 14 Mar 1978. Priority date 10 Jul 1975, Switzerland. 12p.

A method and apparatus for detecting non-combusted fuel components in exhaust gases of a heating installation comprising a collector for collecting the non-combusted fuel components are described. The collector is provided with a probe serving to generate an electrical signal dependent upon the quantity of collected fuel components and with an electrically operating element for the removal of the collected fuel components.

43486 Fuels: the narrowing choice. Northcote, R.D. *Heat. Air Cond. J.;* 47: No. 547, 26-27(Aug 1977).

Paper points out the advantages of modern coal-fired boilers over earlier designs, and describes the arrangements which can be made so that more than one fuel can be burned in the same boiler. The advantages of boilers fired by waste materials, oil and gas are also indicated.

UNDERGROUND ENGINEERING

43487 Borehole instrumentation system for monitoring strata displacement in three dimensions. Smart, B.G.D. (University Coll., Cardiff, Eng.); Singh, R.N.; Issac, A.K. *Int. J. Rock Mech. Min. Sci. Geomech. Abstr.;* **15**: No. 2, 77-85(Apr 1978).

The need for borehole instrumentation to monitor strata displacement in three dimensions around mine openings is examined. Existing techniques are briefly described and a systems analysis approach used to direct and assess innovation. Design details are given of the instrumentation system developed, which utilises a single borehole probe to locate magnetic reference points and monitor inclination in two orthogonal directions, and the accuracy of the system is assessed using a simulated borehole.

POLLUTION CONTROL EQUIPMENT

43488 Inlet duct and hopper apparatus for electrostatic precipitators. Snader, E.S.; McKewen, J.L. (to Environmental Elements Corp.). US Patent 4,026,683. 31 May 1977. Filed date 20 Nov 1975. 8p.

An electrostatic precipitator is described for cleaning a particle-laden gas flowing through a shell with a gas inlet duct and outlet duct, spaced collector electrodes suspended within the shell defining gas passages therebetween, discharge electrodes suspended within the gas passages for ionizing particles in the gas for collection by the collector electrodes, and hoppers suspended below the collector electrodes for collecting the particles. The inlet duct includes a gas distribution baffle having a rigid pervious upper portion and flexible substantially impervious lower portion, preferably a chain curtain, to permit particle accumulations in the inlet duct to pass into the shell for collection in the hoppers. A similar baffle assembly is suspended within each of the hoppers transverse to the gas flow for obstructing the flow of gas through the hoppers and to prevent the particles from becoming lodged between the hopper and the baffle assembly upon discharge of the particles from the hopper.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 43848

43489 (AD-A—047742) **Availability analysis of the Superhilac accelerator. Research report.** Barlow, R.E.; Liang, T.Y. (California Univ., Berkeley (USA). Operations Research Center). Jul 1977. 68p. (ORC—77-21). NTIS PC A04/MF A01.

Records of 26 months of operating, repairing, and maintaining the nuclear accelerator Superhilac at the Lawrence Berkeley Laboratory (LBL) are analyzed with respect to system availability and reliability. A major portion of the report is devoted to building a suitable model for the availability analysis. Some specific recommendations for improvement are also given. The current availabilities for operating the machine in modes 1, 2, and 3 are 64.8%, 76.9%, and 80% respectively. The Adam injector is most responsible for causing the current low availability level of Mode 1. An increase of 15 hours on top of the current MTBF of 22.74 hours for the Adam injector (or, a decrease of about 2 hours from its current MTTR of 5.15 hours) would result in an overall boost of 5.6% for Mode 1 availability. Either way, this would translate into about 6 more usable hours every 4 days of operations for Mode 1. Also included are system reliability and miscellaneous findings from Time Series Analysis and Total Time on Test Plots.

43490 (ANL-HEP-TR—78-19) **Report of the ANL Technical Advisory Panel on physics with polarized beams and targets.** Hendry, A.W.; Arndt, R.A.; Crabb, D.G. (Argonne National Lab., Ill. (USA)). Feb 1978. Contract W-31-109-ENG-38. 38p. Dep. NTIS, MF A01.

Portions of document are illegible.

The ZGS is scheduled for shutdown in October 1979; hence, only a limited number of experiments can yet be done. The first part of this report consists of a brief discussion of recent experimental measurements at the ZGS, their implications, and recommendations for future experiments. Areas included are elastic pp and np scattering, low-energy NN scattering, and experiments at large t. An overall summary showing the various parts of the nucleon—nucleon picture is also given. The second part of the report assembles some useful pieces of nucleon—nucleon information frequently used by researchers in this field. 1 figure, 5 tables. (RWR)

43491 (BNL—50805) **Proposal for a booster to raise the injection energy of the AGS.** Kycia, T.F.; Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 14 Feb 1978. 8p. Dep. NTIS, PC A02/MF A01.

A proposal to insert a small circumference, energy booster between the 200 MeV Linac and the AGS is presented. The possible increase in AGS performance is pointed out. In particular, one can expect an increase in protons on target for the ν program, an increase in anti p flux, an increase in AGS operational reliability and an increase in beam brightness for ISABELLE. In addition, and perhaps most significantly, it could allow rapid current accumulation for ISABELLE with reduced aperture requirement, avoiding altogether the complexities associated with the present rf stacking approach. It is suggested that the existing PPA accelerator can serve as an ideal booster for the AGS complex. Furthermore, this machine is presently available intact. To obtain high brightness beams as well as intense beams, it appears to be necessary to shift to H^- injection from the Linac to the Booster. In this way, it is conceivable that approximately 10^{14} protons per AGS pulse could become a reality. In such an operating mode, extensive rf and shielding modifications would undoubtedly be required. It also appears that AGS beam dumps would become necessary. ISABELLE performance is considered. A possible scenario suggests a bunched beam average luminosity reaching almost 10^{33} $cm^{-2}sec^{-1}$. If debunched, this would fall to approximately 10^{32} $cm^{-2}sec^{-1}$. Also, the simplicity and speed of the proposed operational mode suggests that such performance is in principle the "day-1-performance".

43492 (FERMILAB—78/27) **Environmental monitoring report for calendar year 1978.** Baker, S.I. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 1 May 1978. Contract EY-76-C-02-3000. 59p. Dep. NTIS, PC A04/MF A01.

The results of the environmental monitoring program at Fermi National Accelerator Laboratory (Fermilab) for Calendar Year (CY-) 1977 are given. The Fermilab Facility is a proton synchrotron with a design energy of 200 GeV (billion electron volts); however, the energy reached 500 GeV in 1976 and operation at 400 GeV is now routine. The accelerator operated with about one-third more protons during CY-1977 than in CY-1976. The total number of protons accelerated in 1977 was 2.5×10^{19}. The maximum number of protons accelerated at one time reached half of the planned or design intensity of 5×10^{13} protons per acceleration cycle and typical operation was at about one-third. Thus, environmental monitoring in CY-1977 was done under operation conditions not grossly different from those expected in the future. During CY-1977 there were no abnormal natural occurrences which could have had some impact upon the facility or its operation.

43493 (IAEA—200, pp 41-56) **New high-current relativistic electron beam accelerators at the I.V. Kurchatov Institute of Atomic Energy.** Babykin, M.V.; Baev, B.V.; Baigarin, K.A.; Bartov, A.V.; Gavrin, P.P.; Demidov, B.A.; Korop, E.D.; Mizhiritskii, V.I.; Pasechnikov, A.M.; Sobolev, S.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

The technical characteristics and the results of experiments on the formation of electron pulses and self-focusing of the relativistic electron beams with the Angara-1 and Kal'mar-1 accelerators are described. A maximum voltage of 0.55MV, short circuit currents of 0.4MA and currents of focused electron beams of 0.12MA are achieved.

43494 (LA—7201-MF) **LAMPF (1975—1976) research highlights at the Clinton P. Anderson Meson Physics Facility.** Bowman, J.D.; Burman, R.L. (comps.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 41p. Dep. NTIS, PC A03/MF A01.

An overview is given of some of the research activities at the Los Alamos Meson Physics Facility (LAMPF) covering the period 1975—76. During this time, the proton beam current of the linear accelerator was increased beyond 100 μA, thereby enabling LAMPF to become the world's first true "meson factory". Intense, high-quality beams of protons, neutrons, pions, muons, and neutrinos are available, as well as a number of sophisticated spectrometer systems. The overview begins with a description of the High Resolution Spectrometer, a major LAMPF facility which became operational in the fall of 1976. Various research physicists then describe their own experiments. The experiments selected span the many research areas at LAMPF. Experiments discussed include: (1) observation of the repulsive nature of the p-wave pion-nucleus interaction at large Z; (2) resonances in the photodisintegration of H^- ions; (3) search for the presence of a small parity-violating asymmetry in proton—proton scattering at 15 MeV; (4) SUPERFISH: a cylindrical radio-frequency cavity code precision muonium experiments; (5) observation of pion double-charge-exchange reactions; (6) search for

the direct production of leptons by 256- and 800-MeV protons; (7) nuclear charge distributions from muonic x-ray measurements; (8) scattering of 50-MeV positive pions from nuclei; (9) isotopic neutron radius differences from pion-nucleon total cross-section measurements; and (10) clinical pion radiotherapy.

43495 (LA—7268-PR) **Medium-energy physics program. Progress report, August 1—October 31, 1977.** van Dyck, O.B.; Dunn, E.D. (comps.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 87p. Dep. NTIS, PC A05/MF A01.

A report is given of the medium-energy physics program at the LAMPF linac for the period from August 1 through October 31, 1977. Topics discussed include: (1) accelerator facilities and development; (2) the main beam lines; (3) experimental areas; (4) research; (5) nuclear chemistry; (6) practical applications; (7) linac technology; and (8) management. (PMA)

43496 (SAND—77-1958) **Mechanical engineering and design criteria for the Magnetically Insulated Transmission Experiment Accelerator.** Staller, G.E.; Hamilton, I.D.; Aker, M.F.; Fifer, H.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1978. Contract EY-76-C-04-0789. 21p. Dep. NTIS, PC A02/MF A01.

A single-unit electron beam accelerator was designed, fabricated, and assembled in Sandia's Technical Area V to conduct magnetically insulated transmission experiments. Results of these experiments will be utilized in the future design of larger, more complex accelerators. This design makes optimum use of existing facilities and equipment. When designing new components, possible future applications were considered as well as compatibility with existing facilities and hardware.

43497 **Europe's giant accelerator. The story of the CERN 400 GeV proton synchrotron.** Goldsmith, M.; Shaw, E. London; Taylor and Francis Ltd. (1977). 271p.

A major achievement of our generation is the bringing into operation of the CERN 400 GeV Super Proton Synchrotron, or SPS. This is an event of note and one in which Europeans can take pride. In its essence, the story of the SPS is the story of an engineering project. However, the SPS is not an exercise in applied ingenuity, but a machine with an explicit function to perform—to provide, reliably and economically, beams of high energy particles of pre-determined characteristics for physics experiments. The story of the SPS ends with the drama of the last days leading up to the achievement of full design energy. Since that date in June 1976, full intensity was reached at maximum energy in the following October, and the experimental program got under way in November 1976, so fulfilling the promises that had been made six years before. The essential technical aspects of the machine around which the laboratory is centered are explained in a way that is accessible to readers unfamiliar with the language of high energy physics, or the techniques of the machine builders.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

43498 (SLAC—91(Rev.2)) **TRANSPORT: a computer program for designing charged particle beam transport systems.** Brown, K.L.; Rothacker, F.; Carey, D.C.; Iselin, C. (Stanford Linear Accelerator Center, Calif. (USA); Fermi National Accelerator Lab., Batavia, Ill. (USA); European Organization for Nuclear Research, Geneva (Switzerland)). May 1977. Contract EY-76-C-03-0515. 129p. Dep. NTIS, PC A07/MF A01.

TRANSPORT is a first- and second-order matrix multiplication computer program intended for the design of static-magnetic beam transport systems. It has been in existence in various evolutionary versions since 1963. The present version, described in the manual given, includes both first- and second-order fitting capabilities. TRANSPORT will step through the beam line, element by element, calculating the properties of the beam or other quantities, described below, where requested. Therefore one of the first elements is a specification of the phase space region occupied by the beam entering the system. Magnets and intervening spaces and other elements then follow in the sequence in which they occur in the beam line. Specifications of calculations to be done or of configurations other than normal are placed in the same sequence, at the point where their effect is to be made.

AUXILIARIES AND COMPONENTS

ION SOURCES

REFER ALSO TO CITATION(S) 43820

INJECTION AND EXTRACTION SYSTEMS

43499 (AD-A—048158) **Advanced simulation research. Volume II. Vacuum energy storage. Final report 1 Aug 74—31 Jul 75.** Clark, W.; Korn, P.; Mondelli, A.; Rostoker, N. (Maxwell Labs., Inc., San Diego, Calif. (USA)). 30 Sep 1975. Contract DNA001-74-C-0012. 150p. (MLR—498). NTIS PC A07/MF A01.

The STP experiment has been placed in operation during this contract period. A number of electron injectors have been explored with the injected charge shown to scale linearly with the injector bias voltage. Injected charge levels approximately 100 micro-coulombs, which corresponds to potential well depths of approximately 300 kV, have been measured as will be described in this report. Vertical magnetic field coils have been installed on the experiment, and preparations for high-energy electron injection have been completed. Theoretical studies of high-energy injection, including single-particle and fully-relativistic self-consistent calculations, are presented. In addition, a theoretical study of switching energy stored in the torus is reported.

43500 (CONF-771075—4) **Lifetimes of carbon stripping foils.** Thomas, G.E.; Den Hartog, P.K.; Bicek, J.J.; Yntema, J.L. (Argonne National Lab., Ill. (USA)). 1977. Contract W-7405-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From 6. annual conference of the International Nuclear Target Development Society; Berkeley, CA, USA (19 Oct 1977).

Measurements were made to determine the lifetimes of 5-μg cm^{-2} carbon targets when bombarded by 3-MeV Kr^{+} ions. Stationary, orbiting, and heated targets were tested with both constant and intermittent beams. Preliminary results indicate some lifetime amplification by the use of these devices. An informal discussion of these results is given. 1 figure, 1 table.

43501 **Particle beam injection system.** Jassby, D.L.; Kulsrud, R.M. (to Energy Research and Development Administration). US Patent 4,065,351. 27 Dec 1977. Filed date 25 Mar 1976. 18p.

PAT-APPL-670,480.

A description is given of a poloidal divertor for stacking counterstreaming ion beams to provide high intensity colliding beams. To this end, method and apparatus are provided that inject high energy, high velocity, ordered, atomic deuterium and tritium beams into a lower energy, toroidal, thermal equilibrium, neutral, target plasma column that is magnetically confined along an endless magnetic axis in a strong restoring force magnetic field having helical field lines to produce counterstreaming deuteron and triton beams that are received bent, stacked and transported along the endless axis, while a poloidal divertor removes thermal ions and electrons all along the axis to increase the density of the counterstreaming ion beams and the reaction products resulting therefrom. By balancing the stacking and removal, colliding, strong focused particle beams, reaction products and reactions are produced that convert one form of energy into another form of energy.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 43317

43502 (LA—7221-MS) **Transient thermal stress analysis of a proposed pion production target.** Lindquist, L.O.; Scarbrough, E.C. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

The results of a transient temperature and stress analysis of a proposed LAMPF proton target are presented. The target configuration, suitable for the LAMPF A-1, A-2, or A-5 pion production sites (800-MeV protons, 1-mA average current), is composed of pyrolytic graphite and is cooled by flowing water. Special attention is paid to the pulsed nature of the proton beam (6% duty). The computer code TSAAS is used to develop a temperature and stress history of the target during the first five beam pulses and the final, steady-state temperature distribution. The results of this analysis indicate that a conduction-cooled pyrolytic graphite target of the type shown in this report wil be suitable as a LAMPF pion production target at a beam current of 1 mA.

STORAGE RINGS

REFER ALSO TO CITATION(S) 43491

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 43684

43503 (BNWL—2100(Pt.4), pp 55-61) **Radiation instrumentation: radiological chemistry.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

Program efforts were concentrated in the following areas: development of low-level radiochemical laboratory techniques, in situ monitoring techniques, and activation analysis technology. Four different techniques were evaluated for borehole analysis of uranium and thorium ores. These involved the detection of fission product photons after ^{252}Cf activation, the detection of low-energy gamma rays, the direct measurement of the 1001 keV photon from /sup 242m/Pa, a ^{238}U daughter, and isotopic excitation x-ray fluorescence spectroscopy. X-ray fluorescence spectroscopy and detection of uranium daughter photons allowed 0.01% uranium to be detected. X-ray spectrometry of rare earth elements following activation analysis also allowed better elemental detection sensitivities to be obtained than did the detection of high-energy photons identified with a Ge(Li) detector in typical instrumental neutron activation analysis. An activation analysis facility is under development utilizing ^{252}Cf in a ^{238}U-fueled subcritical assembly. This assembly will be used to develop cyclic activation analysis techniques for some 65 elements in environmental matrices with sensitivities varying from parts per million to parts per billion. A study was initiated to identify instrumentation required for the measurement of transuranium elements associated with power reactor fuels. Transuranium isotopes, ^{237}Pu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{243}Am, and ^{244}Cm can be identified through low energy photons or x-rays emitted following alpha emission with planar intrinsic Ge detectors.

43504 **Highly energy-selective activation detector for pulsed fusion neutron sources.** Howell, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nucl. Instrum. Methods;* **148**: No. 1, 39-42(1 Jan 1978).

An activation detector for neutrons with energies typical of D-T fusion which has null response for neutrons below 10.2 MeV has been constructed. The design is based on using a large oxygen containing liquid scintillator to detect the decay of ^{16}N produced in the $^{16}O(n,p)^{16}N$ reaction. A detector of this type has been calibrated and the null response to lower energy neutrons demonstrated.

43505 **Comparison of sodium iodide and solid-state detectors for the measurement of lung-stored uranium.** King, A.; Scott, L.M.; Disney, J.L. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). *Health Phys.;* **34**: No. 1, 112-115(Jan 1978).

A series of measurement of uranium sources were made, using a solid state detector consisting of 4 high-purity germanium detectors, and compared with measurements made with a single NaI detector. The comparative efficiencies at various energies are shown. As energy increases the differences in efficiencies increase in favour of NaI. A estimate of detection sensitivity gave the limit of error on the net count of a subject with one maximum permissible lung burden as 27 +- 7.2 counts/min for NaI and 3.73 +- 1.04 counts/min for the solid state detector. On a microgram basis the respective limits of error are +- 66 and +- 67 μg. It is concluded that solid state detectors can give 17 times better resolution compared with NaI while maintaining the same detection sensitivity. Sensitivity is related to the scatter of higher energy gammas into a fairly wide energy range. This 17-fold improvement in resolution results in a narrower energy range in which the scattered radiation can fall. Thus gamma analysis with such a system would be less subject to background errors.

43506 **CWRU multiwire proportional counter readout system.** Bevington, P.R.; Leskovec, R.A. (Case Western Reserve Univ., Cleveland, Ohio (USA)). *Nucl. Instrum. Methods;* **147**: No. 2, 431-442(1 Dec 1977).

An electronic system is described which translates pulses from individual wires of multiwire proportional counters into binary addresses indicating the location of the wires in the chambers. The system combines a fast (<100 ns) serial scan of an event buffer with parallel encoding to provide fast transfer of addresses (250 ns per hit). The buffer has provision for disabling the input less than 40 ns after detection of an event to suppress recording of multiple hits caused by individual events. The encoder can digitize the address of every hit encountered or just the first addresses of contiguous hits. The system includes a coincidence trigger for determining whether timing criteria have been satisfied between chambers and with external devices. Events which do not meet the coincidence criteria are typically reset within 400 ns. The addresses are transferred to a computer interface through CAMAC modules. Multiple buffering permits further data acquisition during CAMAC transfer cycles.

43507 **Theoretical evaluation of optimum detector size and positioning for low-energy in vivo gamma spectrometry.** Scott, L.M.; Warner, G.G.; Poston, J.W. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). *Health Phys.;* **33**: No. 6, 583-593(Dec 1977).

Chest cavity monitoring by gamma spectrometry generally utilizes detectors of 12.7, 20.3, or 22.9 cm in diameter, which are positioned according to autopsy data, chest X-rays, or the operator's estimate of lung position. In this study, Monte Carlo techniques and a computer representation of a reference human figure were used to determine optimum detector size and positioning. Escape efficiency for uncollided photons of 16-185 keV was determined for chest, back and sides of the thorax. The effect of non-uniform source positioning was also studied. Given uniform particle distribution, two detectors of 12.7-cm diameter were found to register essentially the same number of photons as one detector of 22.9-cm diameter, even though the latter has nearly 60% more surface area. The optimum detector appears to be a rectangle of approximately 16 x 16 cm. If a detector is to be placed over each lung, the center of each detector is most effectively positioned approximately 20 cm below the top of the shoulder and 10 cm from the midline of the sternum.

RADIATION DOSEMETERS

43508 (AD-A—047853) **Fiber-optics dosimeter for civil defense. Research and development technical report.** Kronenberg, S.; Siebentritt, C. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Nov 1977. 11p. (ECOM—4545). NTIS PC A02/MF A01.

The Defense Civil Preparedness Agency (DCPA) has a requirement for a shelter dosimeter, a standby instrument for monitoring gamma ray doses in the event of an atomic war or a nuclear disaster. Its most important requirement is dependability without reliance on external components such as power sources. Radiation-induced darkening of optical fiber has been utilized to construct such a dosimeter in which the dose dependent darkening of glass fibers is read visually by means of a dose-calibrated gray scale.

43509 **Geiger-Mueller counter for mixed neutron-gamma beam dosimetry.** McDonald, J.C.; Ma, I.C. (Memorial Sloan-Kettering Cancer Center, New York (USA)). *Nucl. Instrum. Methods;* **148**: No. 1, 61-64(1 Jan 1978).

A Geiger-Mueller (G-M) dosimeter has been constructed and employed to measure the gamma-ray component of absorbed dose in a cyclotron produced fast neutron field. This instrument is waterproof for measurements in a liquid medium, and read-out is accompanied with any standard scaler.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 42961, 43579, 43580, 43812

43510 (LLL/M—079) **Computing gamma spectrometer.** McGibbon, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-ENG-48. 194p. Dep. NTIS, PC A09/MF A01.

The operation and service manual for a portable gamma ray spectrometer is presented. The system can use either a sodium iodide detector or a high-purity Ge detector. The design and specifications of the system are given, and instructions for operation, calibration, repair, and maintenance of the spectrometer are elaborated. (WHK)

43511 (UCID—17713) **NUTSPEC: a program for unfolding neutron spectral data obtained with scintillation detectors and gas proportional counters.** Slaughter, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1978. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

NUTSPEC, an interactive program available on the LLL CDC 7600 Octopus Network computers, unfolds neutron spectral data obtained with NE213 and stilbene scintillation detectors, as well as CH_4, H_2, and ^3He gas proportional counters. This document explains how to obtain and execute the program, and describes the input and output data formats used by NUTSPEC. Examples of input files and output plots, along with the user/program interactions, are shown. NUTSPEC also has various graphical display capabilities (TMDS, RJET, FR80).

43512 **Simplified pulse-shape discrimination circuit for use in liquid-scintillation spectroscopy of alpha particles.** Thorngate, J.H. (Oak Ridge National Lab., Tenn. (USA)). *Health Phys.;* **34**: No. 1, 103-106(Jan 1978).

A pulse-shape discrimination circuit is described that is simple to operate and independent of the linear amplifier used for the associated pulse-height measurements. It is essentially a modernization of circuits in which the signal from the anode of the photomultiplier tube is integrated and then doubly differentiated. The pulse-

shape information resides in the fall of the light pulse from the scintillator but occurs in the rise of the integrated pulse which, in turn, affects the length of the initial part of the doubly differentiated pulse. Tests have shown that it has a dynamic range of about 200:1, more than adequate for alpha spectroscopy. Within this dynamic range, its ability to reject electron-produced pulses while retaining alpha-produced pulses is essentially the same as that of more elaborate circuits. The circuit has shown good stability over long runs.

HIGH ENERGY PHYSICS INSTRUMENTATION

43513 Investigation of argon-ethylene mixtures for drift chambers. Palladino, V. (California Univ., Santa Cruz (USA)). *Nucl. Instrum. Methods;* **148**: No. 1, 35-37(1 Jan 1978).

The author uses various argon-ethylene mixtures to study the effects of drift velocity saturation, comparing them to a previously published model. The range of usefulness for drift chamber applications is reported.

43514 Return to unsaturated response of polymeric scintillators excited by relativistic heavy ions. Ahlen, S.P.; Cartwright, B.G.; Tarle, G. (California Univ., Berkeley (USA). Dept. of Physics). *Nucl. Instrum. Methods;* **147**: No. 2, 321-328(1 Dec 1977).

From the response of two scintillators to relativistic ^{20}Ne ions obtained at the Lawrence Berkeley Bevalac, to cosmic-ray iron ions, and to atmospheric muons, it is shown that plastic scintillators provide a very nearly linear response in dE/dx at high charge and relativistic energies, i.e. scintillators become 'unsaturated' in this regime. Scintillators operated in this regime are found to be 'halo' detectors, sensitive almost solely to delta rays with energies above 1.5 keV. A simple algebraic expression is given which permits rapid calculation of scintillator response.

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 42233, 43503, 43528, 43529

43515 (LA—7241-MS) **Influence of access hole parameters on neutron moisture probe readings.** Abeele, W.V. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

Computing soil moisture content with a neutron probe requires use of a calibration curve that considers the thermal neutron capture cross section of the hole liner as well as the hole diameter. The influence of steel, polyvinyl chloride, and aluminum casings that fit 0.051 to 0.102-hole diameters was determined by comparison with neutron probe readings in uncased holes of corresponding diameters. Eccentricity of probe location was considered a potentially significant variable. The relationship between hole diameter and count rate also was investigated. The experiment was run in disturbed Bandelier tuff with an average dry density of 1.2 g . cm^{-3} and moisture content of 1.3 to 35.5% by volume. The casing material and hole diameter influenced the probe readings significantly, whereas eccentric location of the probe did not. Regression analyses showed an almost perfect inverse linear correlation between hole diameter and count rate.

43516 (PB—275737) **Implementation of nuclear gage moisture standards. Final report.** Wyant, D.C. (Virginia Highway and Transportation Research Council, Charlottesville (USA)). Dec 1976. 25p. (VHTRC—77-R31). NTIS PC A02/MF A01.

Two sand and magnesium sulfate moisture standards and a magnesium density standard were implemented into the Virginia Department of Highways and Transportation nuclear moisture gage calibration procedure. In addition to the development of moisture standards, the nuclear program used in determining the moisture calibration curve for a nuclear gage was modified to accept new input data and to provide a more useful output. (Portions of this document are not fully legible)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

43517 (AD-A—047396) **Selected topics in transmission-line theory for EMP internal interaction problems. Final report.** Tesche, F.M.; Liu, T.K. (Science Applications, Inc., Berkeley, Calif. (USA)). Aug 1977. Contract F29601-76-C-0125. 101p. NTIS PC A06/MF A01.

This report discusses a number of modifications of a single-wire transmission line model for use in EMP internal interaction studies. The importance of including the effects of local line perturbations (such as a cable clamp) is discussed in terms of the reflection coefficient presented to waves on the transmission line, and general curves for determining when to neglect such effects are given. Next, the behavior of a finite-length transmission line with periodic loading is investigated and results are compared with those of an infinite line using Floquet's theorem. Finally, the bulk current response of a general multi-conductor transmission is related to the current on a single-wire line and a prescription for determining an equivalent single-wire characteristic impedance and a load impedance from the multiconductor quantities is described.

43518 (AD-A—047918) **ROSCOE manual. Volume 20. Satellite communication model. Final report.** Ostrowsky, H.S.; Garbarino, J.R.; Baltes, J.J. (General Research Corp., Santa Barbara, Calif. (USA)). Jan 1977. Contract DNA001-74-C-0182. 68p. (CR—1-520(Vol.20)). NTIS PC A04/MF A01.

The ROSCOE computer code is designed specifically to be the laboratory standard for evaluating nuclear effects on radar and optical sensors. The program provides a means for evaluating radar acquisition, discrimination, and tracking performance in a nuclear environment; estimating various radar and optical propagation error sources; and computing specific phenomenological data. Volume 20 of this series describes ROSCOE's satellite communication model.

43519 (AD-A—047964) **Bibliography for electrical overstress review. Topical report Mar—Oct 76.** Alexander, D.; Jones, S. (BDM Corp., Albuquerque, N.Mex. (USA)). 10 Oct 1976. Contract DNA001-76-C-0191. 245p. Availability: Microfiche copies only.

The subject report is a bibliographic listing of references used in the preparation of a review of the state-of-the-art in modeling of electrical overstress failures in semiconductors. The report contains three sections with materials arranged by title, author, and subject respectively.

43520 (AD-A—048159) **Processing EMP-related flash x-ray test data with the TRANS2 computer program. Technical memo.** Dietz, J.F.W. (Harry Diamond Labs., Washington, D.C. (USA)). Nov 1977. 46p. (HDL-TM—77-30). NTIS PC A03/MF A01.

When parameters, such as coupled currents, magnetic fields, Compton currents, etc., are measured at a flash x-ray facility, the measured voltages which represent these parameters are a function of the frequency response of the measuring system. By using a measured response (transfer) function for the measuring systems along with Fourier analysis, the computer program TRANS2 transforms measured voltages into the desired parameters.

43521 (AD-A—048264) **Study of radiation-hardened quartz production processes. Final report 10 Jun—31 Dec 76.** Snowden, D.P.; Treadaway, M.J.; Hardwick, W.; Wrobel, T.F.; Flanagan, T.M. (IRT Corp., San Diego, Calif. (USA)). 9 Feb 1977. Contract F19628-76-C-0266. 31p. (IRT—8151-003). NTIS PC A03/MF A01.

The results of an initial program performed by IRT Corporation in support of the RADC/DNA program 'Radiation Hardened Quartz Process Investigations' are presented. Included are calculated depth-dose profiles in the resonator assuming 10-MeV electrons incident on the oscillator package to be used in the resonator evaluation program. Also presented are the results of irradiations of the oscillator package at the RADC facility. Effectiveness of a collimator in protecting oscillator and oven control electronics has been assessed and the results of dose mapping throughout the electronics is presented. Scaling relationships relating dose in the resonator to the dose at an external reference point were developed. Irradiations of a working oscillator were performed to assess the extent of possible experimental anomalies that would impact the actual RADC measurements. The results of the above tasks were evaluated in light of their impact on the RADC program and used to formulate working procedural and/or equipment choice suggestions. In addition, a preliminary study has been made of the hardness assurance requirements for quartz used in quartz crystal filters.

43522 (AD-B—018759) **Electronic subsystem analysis (ESA). Final report 1 March 1975—March 1977.** Lamson, R.; Fitzwilson, R.; Humphry, J. (Questron Corp., San Diego, Calif. (USA)). Jan 1977. Contract F04701-75-C-0109. 34p. NTIS PC A03/MF A01.

The Electronic Subsystem Analysis (ESA) program was a twenty-four month effort from March 1975 through March 1977. The principal activities were conducted for the Space and Missile Systems Organization, Deputy for Re-entry Systems (SAMSO/RS) with supplemental activities conducted for SAMSO, Deputy for Minuteman, the MNNG office. The Electronic Subsystem Analysis program is part of the Advance Ballistic Re-entry Systen (ABRES) re-entry guidance and electronics activities for the establishment of the technologies required to build advanced re-entry guidance systems with the required performance, reliability, and radiation hardness while minimizing size, weight, power and volume.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 42127, 42129, 42276, 43532, 43555

43523 (IS—4378) **Programmers guide to Finger, Thumb, and Triple Axis real time experiment control programs.** Pinter, T.G.; Notis, E.M. (Ames Lab., Iowa (USA)). Mar 1978. Contract W-7405-ENG-82. 97p. Dep. NTIS, PC A05/MF A01.

This manual describes the algorithms and codes written to control the neutron scattering real-time experiments. These experiments consist of three diffractometers, called Thumb, Finger, and Triple Axis, as well as an x-y Plotter. The basic control system consists of an experiment interfaced to an SDS-910 which is in turn interfaced to a PDP-15. All direct experiment control is performed in the 910, e.g., setting angles, handling experiment interrupts, etc. Thus, all three experiments "look" the same to the 15. The Thumb diffractometer consists of a sample table of rotation for the crystal being studied and a detector arm which is rotated about the sample table axis. All other angles are fixed. Thus, only elastic scattering can be performed on this diffractometer. The Finger diffractometer has an analyzing crystal where the Thumb detector is located. This crystal can be rotated to select a given energy from the beam scattered by the sample before it enters the detector. Thus, inelastic scattering can be performed. The Triple Axis resembles the Finger except the monochromator and drum angles as well as the detector and analyzer crystal angles can all move independently.

43524 (MHSMP—77-63) **Pantex Model 121 Streak Camera.** West, G.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Oct 1977. Contract EY-76-C-04-0487. 7p. Dep. NTIS, PC A02/MF A01.

The internal optical system for the Pantex Model 121 Streak Camera was optimized at 1:1 magnification using tools and methods currently available at Pantex. The system performs well, with slight vignetting at small magnification (0.2) with small apertures (0.6 cm or less with 107 cm focal length objective lens).

43525 (SAND—77-1196) **Panel mounted time code reader.** Shaum, R.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1978. Contract EY-76-C-04-0789. 15p. Dep. NTIS, PC A02/MF A01.

The time code reader described is composed of an assembly of commonly available electronic components logically arranged to minimize component count while reliably achieving the basic function of decoding and displaying the time of year information which is available in each of several standard Inter Range Instrumentation Group (IRIG) time codes. The time code reader omits all subsidiary functions of the code except that of retrieving a readable time of year (day, hour, minute, second). The reader can be mounted on any equipment panel having an available flat surface that is 2 by 6 inches in dimensions. IRIG time codes A, B, E, and G can be read without the necessity of switching, and a relatively wide range of input voltages is accommodated.

43526 **Filter type rotor for multistation photometer.** Shumate, S.E. II. (to Energy Research and Development Administration). US Patent 4,035,156. 12 Jul 1977. Filed date 21 Jan 1977. 4p.

PAT-APPL-761,026.

A filter type rotor for a multistation photometer is provided. The rotor design combines the principle of cross-flow filtration with centrifugal sedimentation so that these occur simultaneously as a first stage of processing for suspension type fluids in an analytical type instrument. The rotor is particularly useful in whole blood analysis.

43527 **Temperature sensing device.** Biefeld, R.M.; Ginley, D.S. (to Dept. of Energy). US Patent Application 760,303. 18 Jan 1977. 4p.

This invention relates to a relatively compact and inexpensive device for measuring temperature, wherein a receiver-radiator that may be subjected to a heat zone, is coupled by a conduit with a thermal radiation detector.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 42187, 42233, 42574, 42576

43528 (PB—273454) **Borehole logging with neutron activation; a laboratory assessment. Final report.** Jensen, C.M.; Overmyer, R.F.; Rogers, V.C.; Sandquist, G.M. (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). 30 Jun 1977. Contract H0262057. 43p. NTIS PC A03/MF A01.

A laboratory assessment of prompt and delayed neutron activation analysis with 252Cf and 14MeV neutron sources, for use as an in-situ method of determining low-level copper concentration has been performed. A simulated borehole using porphyry ore was constructed and varying copper concentrations were simulated using copper rods. Prompt neutron activation analysis experiments were consistant with earlier work and do not appear to be feasible for copper concentration of 1.5% or less. Delayed neutron activation analysis experiments indicate that copper ore concentrations of less than 0.1% are detectable using either the 511-KeV gamma-ray of copper-64 or the 1039-KeV gamma-ray of copper-66, with high resolution detectors such as Ge(Li) or intrinsic germanium.

43529 **Background subtraction system for pulsed neutron logging of earth boreholes.** Hopkinson, E.C. (to Dresser Industries, Inc.). US Patent 4,041,309. 9 Aug 1977. Filed date 2 Sep 1976. 10p.

A neutron generator in well logging instrument is pulsed 100 times having a time between pulses of 1400 microseconds. This is followed by an off period of four cycles wherein 2800 microseconds is allowed for capture radiation to decay to an insignificant level and the remaining 2800 microseconds is used to measure background radiation. This results in the neutron source being disabled four pulses after every hundred pulses of operation, or approximately a 4 percent loss of neutron output. A first detector gate is open from 400 to 680 microseconds and a second detector gate is open from 700 to 980 microseconds. During the 100 cycles, each of the gates is thus open for 280 microseconds times 100 for a total of 28,000 microseconds. By scaling the gate count rate by a factor of 10, the background is subtracted directly.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 43338

43530 (AD-A—048003) **Analysis of ground motion data and prediction techniques from the pre-DICE THROW II events. Final report Jan 76—Mar 77.** Perry, G.L.E.; Hudson, C.C.; Loring, B.P. (General Electric Co., Albuquerque, N.Mex. (USA). TEMPO). Mar 1977. Contracts DNA001-75-C-0023;DNA001-76-C-0376. 259p. NTIS PC A12/MF A01.

Twenty-five experimenters and support agencies participated in the pre-DICE THROW II program. This program consisted of two HE events, one using a 100-ton surface-tangent sphere of TNT and the other a 120-ton surface-tangent domed cylinder of bagged ANFO. The purpose of this report is to compare certain aspects of the ground-motion data with the predictions made of these aspects before the tests. Four agencies were charged with providing predictions: Air Force Weapons Laboratory; Waterways Experiment Station R and D Associates and Field Command, DNA. This report consists of seven chapters, which include: A brief description of the initiation of ground motion under a high-explosive detonation ground-motion transducers, canisters, grout and prediction methods; summaries of the data from Events 1 and 2 and comparisons of these with the predictions; analysis and authors' conclusions.

43531 (LA—7140) **Characterization of two commercial explosives.** Craig, B.G.; Johnson, J.N.; Mader, C.L.; Lederman, G.F. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

Experimental data are obtained for the performance of two commercial explosives, an ammonium-nitrate/fuel-oil mixture (ANFO) and a water-gel explosive (WGE-1), using the water-tank, or aquarium, technique. Plexiglas and clay tubes (10- and 20-cm-dia) containing the explosive are submerged in a large transparent water tank. The explosive system is detonated from the top and an image intensifier camera records the shock wave in water as well as the dynamic expansion of the confining cylinder. The experimental data are compared with two-dimensional Lagrangian hydrodynamic calculations based on various assumptions regarding nonideal explosive behavior. The results show that substantial fractions (30 to 50%) of the constituents do not participate in the chemical reaction at the detonation front. For ANFO, complete reaction takes place within a few microseconds behind the detonation front. For WGE-1, detectable additional reaction does not occur within experimental recording time (>200 μs). These results have important applications in effective rock breakage with commercial explosives.

43532 (MHSMP—78-10) **Resistive wire probe using a thin wall tube.** Campos, C.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Mar 1978. Contract EY-76-C-04-0489. 15p. Dep. NTIS, PC A02/MF A01.

A resistive wire probe is being developed which yields a continuous detonation velocity history of high explosives. Molecu-Wire Corporation makes a No. 40 B and S resistive wire which is partially insulated by a skip-wound nylon thread. Recent work has shown that this wire, inside a copper or brass tube, becomes quite sensitive to varying high explosive shock variations. This study made shot-to-shot comparisons and measured detonation velocity with both streak camera and timing switches. The electronics basically consists of a differentiating operational amplifier. Results from

this system were compared to results obtained by mathematically differentiating the same record by use of a computer.

43533 (MHSMP—78-16) **Time measurements for quality control of explosive components.** Avara, R. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Apr 1978. Contract EY-76-C-04-0487. 14p. Dep. NTIS, PC A02/MF A01.

Statistical sampling is employed in quality control of explosive components. Since the samples are destroyed in testing, proper techniques must be developed to obtain the necessary information with adequate precision and minimum risk of equipment failure. Streak camera electro-optical systems are often utilized in tests to measure time dependent data, i.e., velocity, acceleration, simultaneity, etc. As an example, a technique for measuring a component transit time and the simultaneity across the face of an explosive shocked brass cone is briefly described.

43534 (UCRL—50019-77-2, pp 5-8) **Explosives technology.** 19 Jan 1978.

In Organic Materials Division quarterly report, April—June 1977.

Research progress is reported on the following: (1) chemical initiation of gaseous detonation in a small spherical volume; (2) a safe explosive for bench-scale simulation of rock fracturing; and (3) determining the complete expansion isentrope of nitromethane. (TFD)

NUCLEAR

43535 (AD-A—047372) **Validation and refinement of the DELFIC cloud rise module. Final report 28 Oct—22 Dec 75.** Norment, H.G. (Atmospheric Science Associates, Bedford, Mass. (USA)). 15 Jan 1977. Contract DNA001-76-C-0010. 57p. NTIS PC A04/MF A01.

The DELFIC Cloud Rise Module is refined to produce best agreement with stabilized cloud top heights observed from 53 nuclear test shots in the yield range from 21 T to 15 MT. Agreement with observed data, for both cloud tops and bases, is shown to be excellent in the yield range from 0.5 T to 15 MT. Simulated cloud rise and growth also are shown to be in accord with observation. DELFIC cloud top height results are compared with results calculated from a power function of yield. The power function is obtained by least squares curve fitting to observed data. DELFIC yields a proportional reduction in variance of cloud top discrepancies in log space of 59 percent. Sensitivity of results to model structure and to various parameter values is discussed. Use of the model for very high yields (20 to 100 MT) is explored. Limitations of model capability in this yield range are pointed out, and apparent anomalous results are explained.

43536 (AD-A—047385) **Application of FAE technology to the design of nuclear airblast simulation experiments. Final report Sep 26—Feb 77.** Sauer, F.; Stubbs, T. (Physics International Co., San Leandro, Calif. (USA)). Aug 1977. Contract DNA001-76-C-0354. 64p. (PIFR—978). NTIS PC A04/MF A01.

The detonation of fuel aerosols and vapors in air is investigated with respect to the applicability of this type of explosion to generating an airblast simulation a 1-KT nuclear airburst explosion. Extensive investigations into existing overpressure and overpressure-impulse data from weaponized FAE's and carefully controlled hemispherical balloon detonations has allowed a comparison of the fuel-air explosives with both condensed explosives (TNT and nitromethane) and a predicted 1-KT nuclear surface burst. It was found that, depending upon cloud geometry, the total fuel required for a 1-KT nuclear airblast simulation varied between 63 and 200 tons. The concentration of fuel in air must be close to stoichiometric and the mean droplet diameter must be 2500 microns or less. Investigation into existing nozzles indicate that it is questionable whether commercially available nozzles can project a vapor to the requisite height for the 1-KT simulation. Various fuel candidates were investigated. The prop-hydrocarbon compounds are attractive with higher order hydrocarbons being worth consideration.

43537 (AD-A—047388) **Calculations of environments from low-yield nuclear detonations (RAD9 Code results). Final report 1 Mar—30 Jun 76.** Sachs, D.C. (Kaman Sciences Corp., Colorado Springs, Colo. (USA)). Jun 1976. Contract DNA001-75-C-0238. 65p. (K—76-83U(R)). NTIS PC A04/MF A01.

The Defense Nuclear Agency has supported an extensive program to better define the blast, thermal and initial nuclear radiation environments associated with low-yield shallow buried nuclear device detonations. This report and the appendix include detailed results of 2-D rad-hydro computations for two geometries of interest using the KSC version of the RAD9 Code. The RAD9 Code is briefly described and results are shown for a 1-KT source at burial depths of 0.5 and 3.0 meters. Because of the limitations in the scope of work, additional tasks are suggested which would provide information on the effect of yield on air blast and sensitivity of results to equations of state.

43538 (AD-A—047427) **Mighty Epic pre-test analysis. Technical memo.** Crawford, J.; Murtha, R.; Rollins, J.; Thompson, R.; Odello, R. (Civil Engineering Lab. (Navy), Port Hueneme, Calif. (USA)). Mar 1977. 97p. (CEL-TM—51-77-5). NTIS PC A05/MF A01.

Analytical response predictions (pre-shot) are made for three structures that are to be evaluated during the Mighty Epic tests. Also included in the report is a prediction of the response for the free field and for the free field containing a cavity, as well as a study of the effects that various idealization parameters have on the predicted results. The objective of this study is to analytically predict (pre-shot) the response of three structures that are in place at the Mighty Epic test site. These structures consist of: (1) homogeneous sphere; (2) composite built-up liner, and (3) composite integral liner. These three structures are situated in a relatively weak rock (tuff) at the 0.5-Kbar range. Included in the study is a prediction of the response for the free field (i.e., tuff) and for the tuff containing a six-foot diameter cylindrical cavity. Also reported are the effects that the various parameters associated with the predictions have on the results.

43539 (AD-A—047677) **Probabilistic test planning. Final report 13 Dec 76—13 Mar 77.** Evensen, D.A. (Wiggins (J.H.) Co., Redondo Beach, Calif. (USA)). 18 Jul 1977. Contract DNA001-77-C-0082. 52p. NTIS PC A04/MF A01.

A study was conducted to evaluate the failure probabilities for the tunnels to be tested in DIABLO HAWK. The results indicate that 5 to 6 tunnels will be severely damaged, and the test can be improved upon by the addition of one more cylinder. The effects of correlation (among the various structures, concrete, etc.) was simulated computationally using a Monte Carlo procedure. Details of the simulation procedures and the decision theory used are contained in the main text.

43540 (AD-A—048165) **Hussar sword series. MIGHTY EPIC event, consolidated MIGHTY EPIC compression test data for structures and interface experiments. Final project officers report Oct 75—Jun 76.** Piper, H.L. (Defense Nuclear Agency, Washington, D.C. (USA)). 26 Apr 1977. 266p. (DNA-POR—6962). NTIS PC A12/MF A01.

The report consolidates the compression test data and the physical properties data for the various structures, grouts and cores used in the MIGHTY EPIC underground nuclear test. The purpose of this report is to provide data for use in interpreting damage to the MIGHTY EPIC test structures before and after the reloading of the structures in the DIABLO HAWK nuclear event. Results obtained for total load and compressive strength tests on the various structures and surrounding grout mixtures are presented. In addition, the material properties of the N Tunnel complex at the Nevada Test Site are described.

43541 (PB—274998) **Security lighting for nuclear weapons storage sites: a literature review and bibliography. Final report.** Meguire, P.G.; Kramer, J.J.; Stewart, A. (National Bureau of Standards, Washington, D.C. (USA). Law Enforcement Standards Lab.). Nov 1977. 40p. (NBS-SP—480-27). NTIS PC A03/MF A01.

The Defense Nuclear Agency (DNA) program to improve the security of nuclear weapons storage facilities includes consideration of requirements for not only physical barriers and alarm systems but security lighting to aid response force personnel as well. The report presents a literature review and bibliography dealing with optimization of Nuclear Weapons Storage Site (NWSS) security lighting systems design through the application of established principles of human psychological and behavioral functioning. Three distinct psychological/behavioral processes are relevant to security lighting system design: (1) intruder psychological deterrence, (2) detection, and (3) incapacitation. General recommendations for NWSS security lighting system design are provided, based on the literature review and analysis.

WEAPONRY

REFER ALSO TO CITATION(S) 42391, 43100

43542 (AD-A—047389) **Radiation environments from tactical nuclear weapons. Final report 4 Apr 74—22 Jul 76.** Gritzner, M.L.; Albert, T.E.; Straker, E.A.; Smith, H.T. (Science Applications, Inc., Huntsville, Ala. (USA)). Jul 1976. Contract DNA001-74-C-0216. 257p. (SAI—76-534-HU). NTIS PC A12/MF A01.

A comprehensive data base was developed for use in predicting the prompt and delayed radiation components of the free-field and armor shielded tissue dose in an air over ground geometry for arbitrary weapon spectra and heights of burst. For analysis of tactical nuclear weapons, the detector is located 1.75 meters above the ground and results are given for a ground range extending to

1200 meters. In addition, the weapon burst height may vary from surface to a maximum of 1000 meters above ground and yields from 0.01 to 500 kilotons were considered. The calculational methodology is described and the sensitivity of the results to various quantities is presented. Results for selected source spectra are given and compared with results from the literature. Conclusions concerning the data base are presented.

43543 (AD-A—047390) **Version 4 of ATR (air transport of radiation). Final report 8 Aug 73—30 Sep 75.** Huszar, L.; Woolson, W.A.; Straker, E.A. (Science Applications, Inc., La Jolla, Calif. (USA)). Jan 1976. Contract DNA001-74-C-0027. 149p. (SAI—76-561-LJ). NTIS PC A07/MF A01.

This document serves as a guide to Version 4 of ATR (Air Transport of Radiation). This version of ATR contains a parametrization of a comprehensive transport data base for neutrons, secondary gamma rays, prompt gamma rays, x-rays and fission product radiation and provides a detailed description of weapon radiation environments in the atmosphere. This report contains pertinent parts from previous ATR reports as well as descriptions of the new features of the code. Thus it is a definitive user's guide for Version 4.

43544 (UCRL—52386) **Population avoidance in aimpoint selection.** Andre, C.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jan 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

In most past studies of the effectiveness of tactical nuclear weapons vs the amount of collateral damage produced (civilian casualties), civilians have been congregated into idealized shaped towns and cities, and criteria for city avoidance were usually formulated in terms relating to a town's population. This treatment was sufficient in those studies where weapon yields were so large that great numbers of civilians were almost always placed at risk. As further studies developed, demonstrating that real progress could be made in reducing the numbers of civilians potentially placed at risk in tactical nuclear warfare situations, the inadequacies of the present treatment became obvious. The need existed for a more detailed description of the distribution of civilians. The method described determines the number of civilians at risk for a weapon under consideration being detonated at a given point and displays a symbol relating to the numbers at risk on a map or a transparency that overlays a 1:50,000 map of the region. Thus, a weapons planner making the selection of aimpoints for inflicting the necessary military damage required has the means to reduce potential civilian casualties by properly choosing the weapon and aimpoints.

43545 **Ejector rack for nuclear stores.** Peterson, P.F. US Patent 4,049,222. 20 Sep 1977. Filed date 20 Jul 1976. 11p.

A 30 inch ejector rack is described for use with an aircraft, to support and release and/or forcibly eject a nuclear store (or a large conventional store) from the aircraft, with both the ejector rack and the store carried internal of the aircraft. Unlike the prior art, this ejector rack structurally incorporates, among other novel fundamental features and/or improvements: mechanical 'spools', rather than valves or orifices, to obtain pitch or tilt of the store during forced ejection; bypass grooves near the end (i.e., the bottom) of the piston stroke to provide snubber action, thus preventing damage to the store due to impact of the piston and the store during ejection; cartridge debris screens in the gas system of the ejection rack and, structural configuration which permits quick removal of piston components for rapid and easy cleaning, without necessitating the complete disassembly of the ejector rack, or even the removal of the rack from the aircraft to which it is attached.

EXPLOSION DETECTION

43546 (AD-A—047310) **Vela network evaluation and automatic processing research. Quarterly report No. 4, 1 July—30 September 1977.** Sax, R.L. (Texas Instruments, Inc., Dallas (USA)). 3 Oct 1977. Contract F08606-77-C-0004. 23p. NTIS PC A02/MF A01.

Research progress under the VELA Network and Automatic Processing Research program is summarized in the following areas: Evaluation of the Iranian Long Period Array (ILPA) and the Seismic Research Observatories (SRO) data; Development of detection methods; Methods of extracting long-period event waveforms; Interactive seismic; signal processing; Determining path corrections, and Extracting source parameters from long-period data.

43547 (AD-A—047374) **Hussar sword series. HUSKY PUP Event. Development and testing of an earth displacement sensor. Final report Sep 75—Sep 76.** Hollister, H.; Cole, E.L.; Lew, M.A. (Kaman Sciences Corp., Colorado Springs, Colo. (USA)). Sep 1976. Contract DNA001-75-C-0277. 160p. (K—76-112U(R)). NTIS PC A08/MF A01.

This report describes the effort toward development of an Earth Displacement Sensor (EDS) for direct measurement of earth particle velocity and displacement in an underground test environment. The objective of this development was a sensor capable of direct measurement of earth displacement thereby avoiding errors associated with integration of acceleration or velocity measurements. The EDS consists of an inertially isolated radial field magnet within a long tube which is embedded in the earth. Discrete pickup coils are distributed along the length of the tube. As the tube moves with the earth motion, a signal is induced in the coils moving through the magnetic field. Determination of which coil is producing the signal at any given time yields a direct measurement of the earth position at that time. Additionally, the amplitudes of the signals are proportional to the earth particle velocity. Details of the EDS design and related analysis are described and results of laboratory tests are presented along with field test results from event HUSKY PUP.

43548 (AD-A—047382) **The seismological evidence for the triggering of block motion by large explosions. Topical report 26 Sep 75—31 Dec 76.** Bache, T.C.; Lambert, D.G. (Systems, Science and Software, La Jolla, Calif. (USA)). Dec 1976. Contract DNA001-76-C-0072. 46p. (SSS-R—77-3118). NTIS PC A03/MF A01.

The seismological evidence for the triggering of block motion by large nuclear explosions is evaluated. While ultimate interest is on the block motion at depth from large surface bursts, the paucity of data for such events makes it necessary to focus on contained explosions. The emphasis is on contained explosions at NTS since most U.S. data are from these events, but the nuclear experiments in Alaska, Colorado, and Mississippi are also discussed. The key parameter controlling block motion is found to be the level of tectonic stress in the vicinity of the explosion. It seems unlikely that significant block motions (large relative displacement outside the explosion produced shatter zone) were associated with post explosions except within a few hundred meters of the surface where the lithostatic pressure is low. Explosion aftershocks that occur for days after the event can cause block motions at considerable distances from the explosion. A quite cautious upper limit on the associated block motions observed for the megaton event BENHAM is about 50 cm at ranges up to 10 km or so.

43549 (UCID—17728) **Criteria for the PNE seismic network.** Pruvost, N.L. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Mar 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

A 1976 treaty between the United States and the Soviet Union permits a local seismic network to be deployed at the site of a peaceful nuclear explosion to monitor the event. Criteria for the design and selection of the data-acquisition equipment for such a network are provided. Constraints imposed by the protocol of the treaty, the environment, and the expected properties of seismic signals (based on experiences at the Nevada Test Site) are discussed. Conclusions are drawn about the desired operating mode. Criteria for a general seismic instrumentation system are described.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 43081

BASIC STUDIES

REFER ALSO TO CITATION(S) 42173, 43566

43550 (ANL/RER—78-1) **Three-dimensional, second-order closure numerical model of mesoscale circulations in the lower atmosphere: description of the basic model and an application to the simulation of the environmental effects of a large cooling pond.** Yamada, T. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 92p. Dep. NTIS, PC A05/MF A01.

Portions of document are illegible.

A detailed description is presented of a three-dimensional, mesoscale model of circulations in the lowest few kilometers of the atmosphere, the planetary boundary layer. The model is termed a turbulence second-moment closure model since it is based on various second-moment turbulence equations involving wind velocity, temperature, water vapor, and liquid water. A simplified version of the model, in which only time-dependent, partial-differential equations for the turbulence energy balance and a master length scale is recommended. A Gaussian probability function for cloud cover statistics is used in order to model condensation processes. Thus not only are the effects of thermal and moisture stratification included but the effects of condensation are considered as well. As one example of an environmental assessment application, the model is used to simulate formation of clouds over a cooling pond, and the

results obtained are qualitatively compared with an observation of this inadvertent modification of local weather.

43551 (BNL—24190) **Turbulence during high wind episodes in a coastal region.** SethuRaman, S. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1978. Contract EY-76-C-02-0016. 5p. (CONF-780210—2). Dep. NTIS, PC A02/MF A01.

From 3. conference on wind engineering research; Gainesville, FL, USA (26 Feb 1978).

Turbulence in the atmospheric surface layer caused by aerodynamic roughness and temperature variations induces different degrees of mixing leading to various boundary layer processes. Random fluctuations of velocity and pressure in the atmosphere also causes random motions of structures, sometimes resonant in nature. Structural failures mostly occur during high wind conditions when the amplitudes of fluctuations are the highest and the scales of turbulence the smallest. Such failures occur due to the complex combination of the atmospheric turbulence and the structure induced turbulence. The purpose of this paper is to investigate the structure of turbulence in the atmospheric surface layer in a coastal area during high wind conditions and compare the results with similar observations inland.

43552 (COO—2455-17) **Theories of atmospheric transport and diffusion.** Kao, S.K. (Utah Univ., Salt Lake City (USA). Dept. of Meteorology). Jan 1978. Contract EY-76-S-02-2455. 141p. Dep. NTIS, PC A07/MF A01.

Atmospheric transport and diffusion in the planetary boundary layer is discussed. Basic tools for analyzing turbulent motion and diffusion are described and basic theories of transport and diffusion of pollutants in the Eulerian and Lagrangian systems are presented. 150 references.

43553 (PB—27497) **Proceedings of the Stationary Source Combustion Symposium (2nd) held at New Orleans, Louisiana on August 29—September 1, 1977. Volume V. Addendum.** Bowen, J.S.; Hall, R.E. (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Industrial Environmental Research Lab.). Jul 1977. 216p. (EPA/600/7—77/073e). NTIS PC A10/MF A01.

Contents: Effects of fuel and atomization on NOx control for heavy liquid fuel-fired package boilers, NOx control techiques for package boilers - Comparison of burner design, fuel modification and combustion modification; Design and scale-up of low emission burners for industrial and utility boilers; Statistical considerations important in analyzing measured changes in water-wall tube thickness; Federal regulations; Existing stationary combustion source air pollution regulations; Emission characteristics of small stationary diesel engines; Evaluation of combustor design concepts for advanced energy conversion systems; Fluidized bed combustion; Coal-oil mixture combustion technology; Advanced combined cycles; Advanced combustion systems for stationary gas turbines.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42172, 42252, 42286, 42419, 42642, 43234, 43356, 43360, 43363, 43588, 43718, 43722, 43727, 43737, 43738

43554 (BNWL—2100(Pt.4), pp 92-94) **Applications of holography.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 4. Physical and technological programs.

Holography using short laser pulses is being studied to determine its applicability to environmental air pollution monitoring. A Q-switched Korad 1500 ruby laser is being used for laboratory experiments to determine spatial and temporal resolving capability. Demonstration experiments simulating two applications were performed with satisfactory results.

43555 (COO—4319-1) **Development of an aerosol size classifier. Progress report, May 31, 1977—January 31, 1978.** Forney, L.J.; Ravenhall, D.G. (Illinois Univ., Urbana (USA)). Jan 1978. Contract EE-77-S-02-4319. 120p. Dep. NTIS, PC A06/MF A01.

The purpose of this research is to characterize the performance of rectangular slit virtual impactors. A mathematical description of two-dimensional jets of ideal fluid impinging upon a void has been developed using conformal mapping techniques. The analysis includes fluid deflecting plates of finite length inclined at arbitrary angles to the incident jet. Particle trajectories were simulated for various theoretically admissible instrument geometries. Salient features of the particle sizing effectiveness of such devices were determined for a range of void space openings $h/w > 1$ combined with jet to plate spacing s/w ranging from 0 to 2. Visual observations of two-dimensional jets impinging upon a void were conducted with a scaled-up water model. It was found that excess fluid flux into the void is minimized for a range of jet Reynolds numbers of $750 < Re < 1500$. At smaller values of Re wall boundary layers interfere while at larger Re jet core instabilities develop. Modifications were made on an existing prototype virtual impactor to eliminate internal wall losses. Experiments are being performed using mono-dispersed 2.5 μm DOP particles to determine the magnitude of the internal losses and to fully characterize the instrument response.

43556 (LA-UR—78-959) **Estimation of expected value for log-normal and gamma distributions.** White, G.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 28p. (CONF-780212—3). Dep. NTIS, PC A03/MF A01.

From Plutonium information conference; San Diego, CA, USA (28 Feb 1978).

Portions of document are illegible.

Concentrations of environmental pollutants tend to follow positively skewed frequency distributions. Two such density functions are the gamma and lognormal. Minimum variance unbiased estimators of the expected value for both densities are available. The small sample statistical properties of each of these estimators were compared for its own distribution, as well as the other distribution to check the robustness of the estimator. Results indicated that the arithmetic mean provides an unbiased estimator when the underlying density function of the sample is either lognormal or gamma, and that the achieved coverage of the confidence interval is greater than 75 percent for coefficients of variation less than two. Further Monte Carlo simulations were conducted to study the robustness of the above estimators by simulating a lognormal or gamma distribution with the expected value of a particular observation selected from a uniform distribution before the lognormal or gamma observation is generated. Again, the arithmetic mean provides an unbiased estimate of expected value, and the achieved coverage of the confidence interval is greater than 75 percent for coefficients of variation less than two.

43557 (N—77-31669) **Ground cloud effluent measurements during the May 30, 1974, Titan 3 launch at the Air Force eastern test range.** Bendura, R.J.; Crumbly, K.H. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Sep 1977. 50p. (NASA-TM-X—3539; L—11372). NTIS PC A03/MF A01.

Surface-level exhaust effluent measurements of HCl, CO, and particulates, ground-cloud behavior, and some comparisons with model predictions for the launch of a Titan 3 rocket are presented along with a limited amount of airborne sampling measurements of other cloud species (O3, NO, NOX). Values above background levels for these effluents were obtained at 20 of the 30 instrument sites; these values were lower than model predictions and did not exceed public health standards. Cloud rise rate, stabilization altitude, and volume are compared with results from previous launches.

43558 (N—7732622) **An ultraviolet video technique for visualization of stack plumes and for measuring sulfur dioxide concentration and effluent velocity.** Exton, R.J. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Sep 1977. 38p. (NASA-TP—1014; L—11628). NTIS PC A03/MF A01.

Absorption spectroscopy utilizing a video sensing technique was investigated as a means of visualizing SO2 in power plant stack plumes and for measuring SO2 concentration and effluent velocity in these plumes. The absorption of SO2 is measured in the ultraviolet region by using the sky as a background source. An additional spectral channel is used to correct for particulate scattering encountered in coal fired power plant plumes. The video system also tracks fluctuations in the SO2 concentration which leads to the determination of an eddy convection velocity. Field measurements were performed to show that the eddy convection velocity is proportional to the average in-stack velocity and to empirically determine their relationship. It was concluded that the video absorption technique is an attractive method for remotely determining both SO2 concentration and plume velocity with the same instrument.

43559 (ORNL/TM—6364) **AREAS: a computer code for estimating air pollutant concentrations from dispersed sources.** Moore, R.E. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 42p. Dep. NTIS, PC A03/MF A01.

The AREAS area-source computer code, written in FORTRAN IV, is described and listed. This code, which runs in less than 7 seconds on the IBM 360/91 computer, estimates annual-average concentrations of an air pollutant at ground level in each of 400 grid squares in a 20 by 20 area reference grid. AREAS can be used for multiple, dispersed sources located in each of the 400 grid squares by treating them as area sources. Required input includes 20 by 20 arrays of annual-average point-source chi/Q values generated by use of a point-source model or computer code for specific grid sizes relative to the size of the area reference grid. AREAS can be applied to any size area for which a uniform meteorology can be assumed. It has been applied to dispersed emissions of fossil fuel combustion

products and automobile emissions in Roane County, Tennessee, and to the atmospheric dispersion of radionuclides emitted from the tailings piles of uranium mills.

43560 (PB—273153) **Aerosol Research Branch, annual report FY 1976/76a federal interagency energy/environment research and development program. Final report.** Wilson, W.E.; Danskin, C. (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Environmental Sciences Research Lab.). Aug 1977. 69p. (EPA/600/7—77/076). NTIS PC A04/MF A01.

The research program of the Aerosol Research Branch includes research grants and contracts at institutions in many parts of the United States, in addition to an intramural program. The purpose of these projects is to study the chemical and physical properties of aerosols, identify the mechanisms of aerosol formation and removal, and conduct experiments to measure these rates. The results of the research are being used (1) to establish the contribution of the various sources to the ambient atmospheric aerosol loading, (2) to characterize urban, natural, and primary and secondary aerosols, (3) to develop quantitative descriptions of the generation and removal rates associated with each major aerosol source and sink, (4) to quantify the effects of aerosol on atmospheric chemical reactions, and (5) as a scientific basis for recommending regulatory actions concerned with air quality improvements.

43561 (PB—273218) **Aerosol Research Branch, annual report fy 1976/76a. Final report.** Wilson, W.E.; Danskin, C. (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Environmental Sciences Research Lab.). Aug 1977. 146p. NTIS PC A07/MF A01.

The research program of the Aerosol Research Branch includes research grants and contracts at institutions in many parts of the United States, in addition to an intramural program. The purpose of these projects is to study the chemical and physical properties of aerosols, identify the mechanisms of aerosol formation and removal, and conduct experiments to measure these rates. The results of the research are being used (1) to establish the contribution of the various sources to the ambient atmospheric aerosol loading, (2) to characterize urban, natural, and primary and secondary aerosols, (3) to develop quantitative descriptions of the generation and removal rates associated with each major aerosol source and sink, (4) to quantify the effects of aerosol on atmospheric chemical reactions, and (5) as a scientific basis for recommending regulatory actions concerned with air quality improvements. The research projects funded under EPA's base program are described.

43562 (PB—273441) **Air quality data: 1976 first quarter statistics. Quarterly report, January—March 1976.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Monitoring and Data Analysis Div.). Aug 1977. 121p. (EPA—450/2/77/014). NTIS PC A06/MF A01.

This report is a statistical summary report on ambient air quality submitted to EPA from air monitoring operations of State, local and Federal networks in accordance with requirements of the Clean Air Act and EPA Regulations for State Implementation Plans (SIPs). These data represent all ambient air quality data sampled for pollutants that currently have National Ambient Air Quality Standards.

43563 (PB—273442) **Air quality data: 1976 second quarter statistics. Quarterly report, April—June 1976.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Monitoring and Data Analysis Div.). Aug 1977. 104p. (EPA—450/2/77/015). NTIS PC A06/MF A01.

This report is a statistical summary report on ambient air quality submitted to EPA from air monitoring operations of State, local and Federal networks in accordance with requirements of the Clean Air Act and EPA Regulations for State Implementation Plans (SIPs). These data represent all ambient air quality data sampled for pollutants that currently have National Ambient Air Quality Standards.

43564 (PB—273443) **Air quality data: 1976 third quarter statistics. Quarterly report, July—September 1976.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Monitoring and Data Analysis Div.). Aug 1977. 85p. (EPA/450/2—77/016). NTIS PC A05/MF A01.

This report is a statistical summary report on ambient air quality submitted to EPA from air monitoring operations of State, local and Federal networks in accordance with requirements of the Clean Air Act and EPA Regulations for State Implementation Plans (SIPs). These data represent all ambient air quality data sampled for pollutants that currently have National Ambient Air Quality Standards.

43565 (PB—273472) **Variables affecting air quality instrument operation. Interim report.** Peter, R.R.; Pinkerman, K.O.; Shirley, E.C. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). Jul 1977. Contract DOT-FH-11-7730. 82p. NTIS PC A05/MF A01.

When an air pollution monitoring system is put into operation, it should be analyzed to determine whether system variables will affect the output of analytical instruments within the system. An analysis of the monitoring system of a Caltrans air pollution research van is presented. This analysis investigates the effects of several system variables on instrument response, including the length of the sample intake lines, variation in instrument supply voltage, van interior temperature, soiling of intake line filters and the retention time of air samples in teflon bags. Where system variables are found to affect instrument response, regression equations were developed which correct for the effects of these variables.

43566 (PB—273503) **Regional air pollution study: off-highway mobile source emission inventory. Final report.** Littman, F.E.; Isam, K.M. (Rockwell International Corp., Creve Couer, Mo. (USA). Air Monitoring Center). Oct 1977. Contract EPA-68-02-2093. 50p. NTIS PC A03/MF A01.

An emission inventory of mobile off-highway sources of air pollution has been determined for the Regional Air Pollution Study (RAPS) in St. Louis, Missouri. Emissions of HC, CO, NOx, SOx and particulate matter have been calculated with the aid of a computer for the 1,989 grid squares comprising the St. Louis Air Quality Control Region. Source categories included motorcycles, lawn and garden equipment, industrial equipment, construction equipment, farm equipment and outboard motorboats. Emissions contributed by each category were treated separately. Simplifying assumptions pertaining to area distribution of source populations and usage were used to make calculations possible which generally inadequate data would have otherwise prohibited. The procedures involved in arriving at grid element emission values are described in detail.

43567 (PB—273504) **Sulfur dioxide bubbler temperature study.** Martin, B.E. (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Environmental Monitoring and Support Lab.). Aug 1977. 32p. (EPA—600/4/77/040). NTIS PC A03/MF A01.

This paper describes a series of temperature-controlled studies designed to determine the temperature characteristics of several thermostated systems used to collect sulfur dioxide from the ambient air by the EPA Federal Reference Method.

43568 (PB—273518) **Quality assurance handbook for air pollution measurement systems. Volume II. Ambient air specific methods.** von Lehmden, D.J.; Nelson, C. (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Environmental Monitoring and Support Lab.). May 1977. Contract EPA-68-01-4147. 279p. (EPA—600/4/77/027a). NTIS PC A13/MF A01.

This Handbook includes quality assurance guidelines on ambient air measurement systems. Regardless of the scope and magnitude of the ambient air measurement system, there are a number of common considerations pertinent to the production of quality data. These common parameters are discussed in Section 2.0 of Volume II and include quality assurance guidelines in the areas of: (1) Sampling site selection considerations, (2) Sampling considerations, (3) Data handling and reporting, (4) Compliance monitoring reference and equivalent methods, and (5) Recommended minimum quality assurance program for ambient air monitoring systems. The remainder of Volume II contains pollutant-specific quality assurance guidelines. Initially Volume II includes guidelines for the following pollutant-specific measurement systems: Section 2.1 reference method for determination of sulfur dioxide (pararosaniline method) and Section 2.2 reference method for determination of suspended particulates (high volume method). Operators and managers responsible for ambient air measurements will find Volume II useful in planning quality assurance.

43569 (PB—274527) **Improvements to single-source model. Volume 3. Further analysis of modeling results. Final report.** Mills, M.T. (GCA Corp., Bedford, Mass. (USA). GCA Technology Div.). Aug 1977. Contract EPA-68-02-1376. 159p. (GCA-TR—76-6-G(3)). NTIS PC A08/MF A01.

This report documents an evaluation of the model performance stratified by six stability classes, three wind speed classes, and three mixing height classes. The model accuracy is found to be dependent on stability class. For stabilities A and B, the model shows some tendency to overestimate concentrations, especially near the plant. For stabilities D, E, and F, the model greatly underestimates concentrations at all but the most distant sampler. For stability C, the model tends to agree with the measurements. Higher wind speeds result in a trend toward overestimates at the Muskingum plant, and a trend toward underestimates at the Canal plant. For the Canal plant, there does not appear to be a definite pattern between the accuracy of the model estimates and mixing height. However, at the Muskingum plant, large underestimates occur for the lowest mixing height class. This implies that the model is treating the plume as penetrating the top of the mixed layer (with resulting concentration estimates of zero) more frequently than actually happens.

43570 (PB—275458) **Characterization of the Washington, DC oxidant problem. Final report.** Record, F.A. (GCA Corp., Bedford, Mass. (USA). GCA Technology Div.). Sep 1977. Contract EPA-68-02-1376. 269p. (GCA-TR—77-11-G(1)). NTIS PC A12/MF A01.

This report describes the results of a study to characterize the oxidant problem in the Washington, D.C., metropolitan area. Emphasis is placed on ambient monitoring data on ozone, nitrogen oxides, and nonmethane hydrocarbon concentrations observed during Summer, 1976. Additional data collected during the study and summarized in the report include: surface and upper air meteorological data, aircraft observations of O_3, NO, NOx, SO_2, and condensation nuclei, and hydrocarbon species data. Both horizontal and vertical ozone profiles obtained during the two weeks of aircraft sampling in and around the Washington, D.C., area are presented. Results of trajectory studies, hydrocarbon composition analyses, and analyses of the ambient concentration data are summarized in numerous figures and tables. HC and NOx emission inventories compiled by MWCOG are provided.

43571 (PB—275525) **Compilation of air pollutant emission factors. Third edition. Parts A and B (including supplements 1 through 7).** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Aug 1977. 511p. (AP—42-ED-3-PTS-A/B). NTIS PC A22/MF A01.

Emission data obtained from source tests, material balance studies, engineering estimates, etc., have been compiled for use by individuals and groups responsible for conducting air pollution emission inventories. Emission factors given in this document, the result of the expansion and continuation of earlier work, cover most of the common emission categories: fuel combustion by stationary and mobile sources; combustion of solid wastes; evaporation of fuels, solvents, and other volatile substances; various industrial processes; and miscellaneous sources. When no specific source-test data are available, these factors can be used to estimate the quantities of primary pollutants (particulates, CO, SO2, NOx, and hydrocarbons) being released from a source or source group.

43572 (UCID—17813) **Some observations of suspension of dust by wind from dry lakes.** Homan, D.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

Particle concentrations of dust in air were measured as a function of wind at two dry lakes at the Nevada Test Site (NTS) during the spring and summer of 1975. Particle concentrations (0.5 to 12 μm diameter) varied widely for both windy and calm conditions with substantial overlap in the data for the two conditions. The average particle concentration during the transition from calm to windy conditions was found in some cases to decrease as the wind increased; particle concentrations during windy conditions were typically characterized by short bursts, decreasinhg in frequency and intensity as the wind continues. Gust fronts, the rapid onset of stronger gusty winds, caused the greatest bursts of dust suspension.

43573 (UCRL—80397) **Effects of a massive pulse injection of NO/sub x/ into the stratosphere.** Duewer, W.H.; Wuebbles, D.J.; Chang, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

Recent measurements of chemical reaction rates have greatly reduced the modeled sensitivity of stratospheric ozone toward injections of NO/sub x/ (NO/sub x/ = NO + NO_2) in amounts comparable to the natural NO/sub x/ inventory. Most of this reduced effect results from interference between NO/sub x/ and HO/sub x/ catalytic ozone destruction mechanisms. For very large NO/sub x/ injections (such as might be generated from a major nuclear exchange involving devices of greater than one megaton yield) the interfering processes saturate and large ozone depletions are still computed. Smaller total injections or lower altitude injections (such as might be generated by sub megaton devices) have much lesser computed effects.

43574 (UCRL—80428) **MAP3S update: summary of research activities.** MacCracken, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1978. Contract W-7405-ENG-48. 13p. (CONF-780428—1). Dep. NTIS, PC A02/MF A01.

From Meeting on atmospheric sulfates; Philadelphia, PA, USA (13 Apr 1978).

The goal of the Multi-state Atmospheric Power Production Pollution Study (MAP3S) is to develop and demonstrate an improved, verified capability to simulate the present and potential future changes in pollutant concentration, atmospheric behavior and precipitation chemistry as a result of pollutant releases to the atmosphere from large-scale power production processes, primarily sulfur oxide emissions from coal combustion in electric power plants. The study domain is the high population, energy intensive northeastern quadrant of the United States. Research projects are underway to measure present sulfur oxide concentrations and composition, to assess the potential for long range transport, to investigate transformation processes in plumes from point and urban sources, to sample precipitation chemistry and improve understanding of scavenging mechanisms, and to develop numerical models that can simulate future air quality on sub-continental scales given patterns of anticipated combustion emissions.

43575 **Changes of land biota and their importance for the carbon cycle.** Bolin, B. *Science;* **196**: No. 4290, 613-615(6 May 1977).

The report compares the increase in atmospheric carbon dioxide due to the expansion of forestry and agriculture with that due to fossil fuel combustion. Tables show the net primary production and biomass of land biota for different types of vegetation, the production of wood and the input of carbon dioxide into the atmosphere due to land modifications. The author concludes that the input of carbon to the atmosphere from this cause since the early 19th century is 50 plus or minus 25% of the amount due to fossil fuel combustion; the present annual input being 10 to 35% of the present emission from the use of fossil fuels. The atmospheric carbon dioxide concentration has increased since the early 19th century by 35 to 50 ppM. If 40 +/-5% of the net output of carbon dioxide due to human activities has remained airborne instead of 50% as assumed previously, then future increases might be delayed provided depletion of the world's forests is stopped.

43576 **Application of GC-MS to the analysis of PAH in environmental samples.** Lao, R.C.; Thomas, R.S.; Monkman, J.L. (Dept. of the Environment, Ottawa). pp 271-281 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Increasing attention is being given to the contribution of PAH to overall environmental pollution. Investigations of PAH concentrations in the environment have aroused public concern about the impact of these compounds upon the biosphere. The low concentrations of PAH, normally found in ambient air, require extreme care at all stages of the analytic process, including sampling, to avoid adventitious contamination. Sample preparation, extraction and clean up are fundamental parts of PAH analysis. All determinations must be based upon pure reference materials, corresponding to individual compounds found in the sample and such reference materials are not generally available. The GLC-FID-Quadrupole-MS-computer system is, at present, the method of choice for PAH analysis for all types of environmental samples.

43577 **Analysis of polynuclear aromatic hydrocarbons in the respiratory environment.** Brunnemann, K.D.; Hoffmann, D. (American Health Foundation, Valhalla, NY). pp 283-297 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The PAH analysis of the two smoke products revealed that in fact the concentration of carcinogenic PAH in the smoke from Burley tobacco (24 ng/cig. BaP) is much lower than that in the smoke of Bright tobacco (53 ng BaP/cig.). An explanation for this was found in the fact that only Burley tobacco contained alkali nitrates (1—5%) and that these nitrates form nitrogen oxides during smoking. The thermically activated nitrogen oxides, however, react as scavengers with C,H-radicals under formation of nitro-hydrocarbons and other compounds inhibiting the pyrosynthesis of PAH from C,H-radicals, explaining at least partially the reduced carcinogenicity of the smoke from nitrate rich tobacco. Studies along this line have been and continue to be most valuable in designing models toward a less harmful cigarette, a major goal in tobacco carcinogenesis. We believe that much more emphasis should be placed on the modification of combustions with respect to the reduction of PAH emission in order to minimize the most abundant carcinogens in the nonoccupational respiratory environment.

43578 **Low-temperature Fourier transform infrared spectroscopy of polynuclear aromatic hydrocarbons.** Wehry, E.L.; Mamantov, G.; Kemmerer, R.R.; Brotherton, H.O.; Stroupe, R.C. (Univ. of Tennessee, Knoxville). pp 299-309 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The utility of using Fourier transform infrared spectroscopy as a tool for the analysis of polycyclic organic matter is assessed. Since 1972, significant advances in IR spectroscopic instrumentation have occurred which alleviate many of the disadvantages earlier encountered. The principal difference between conventional IR techniques and Fourier transform IR spectroscopy is that the latter method is a multiplex technique, i.e., all resolution elements in the spectrum are examined simultaneously. Initial studies have been concerned with the acquisition of a library of standard spectra of pure substances, the examination of simple synthetic mixtures of polynuclear hydrocarbons, and comparisons of spectra obtained by different techniques. Plans for future experimental work are outlined.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 43559

43579 (BNWL—2100(Pt.4), pp 85-87) **Analytical techniques for ^{99}Tc measurement in environmental samples.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 4. Physical and technological programs.

A highly sensitive mass spectrometric technique was developed for measurement of ^{99}Tc in environmental samples. The feasibility of this approach has been demonstrated, and necessary refinements are now being made to the radiochemical and mass spectrometric procedures. Interfacing of the mass spectrometer to a highly flexible and sophisticated PDP-11 based computer system has been accomplished. It is anticipated that measurements of ^{99}Tc at the picogram or subpicogram level will be possible by this technique.

43580 (BNWL—2100(Pt.4), pp 95-97) **Real-time measurement of Pu in air at below MPC levels.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 4. Physical and technological programs.

A direct-inlet mass spectrometer was developed for monitoring low-level airborne plutonium on a real-time basis. The instrument is capable of measuring plutonium concentrations below the MPC level. Construction of the spectrometer has been completed. A minicomputer-based data acquisition system is nearing completion. Instrument calibration for absolute particle-size measurement is in progress.

43581 (ORNL—5348) **Workshop on dosimetry for radon and radon daughters.** Turner, J.E.; Holoway, C.F.; Loebl, A.S. (eds.). (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 56p. Dep. NTIS, PC A04/MF A01.

Emphasis is placed on the dosimetry for radon and daughters, rather than on monitoring and instrumentation. The objectives of the meeting were to exchange scientific information, to identify problem areas in radon-daughter dosimetry, and to make any observations or recommendations by the participants through issuance of this report. The discussion topics included the history of dosimetry for radon and daughters, human data, aerosols, deposition and movement in the respiratory tract, dose calculations, dose-to-working-level-month (WLM) conversion factors, animal experiments, and the development of regulations and remedial criteria for reducing population exposures to radon daughters. This report contains a summary of Workshop discussions plus individual statements contributed by several of the participants. The outstanding problem areas from the standpoint of dosimetry appear to involve the appropriate lung organ mass to be used (average lung-tissue dose vs. high-level local dose); recognition of the discrete, rather than continuous, structure of the mucus; lack of knowledge about lung clearance; the variability of dose with the degree of disequilibrium and the unattached fraction of radon daughters for a given WLM; and questions about the character of uranium mine atmospheres actually breathed in the older mines from which much of the epidemiological information originates. The development of criteria for taking remedial action to reduce exposures involves additional concerns of basing long-term risk assessment on short-term sampling and applying WLM data for miners to general populations.

43582 (SAND—78-0620) **Environmental monitoring report: Sandia Laboratories, 1977.** Simmons, T.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 24p. Dep. NTIS, PC A02/MF A01.

The environmental monitoring for calendar year 1977 shows that concentrations of radioactive materials in the Albuquerque area are typical of natural background for the area. An estimated 0.055 person-rem Albuquerque area (80 km radius) population dose commitment results from calculated Sandia Laboratories releases. Over the same area 57,000 person-rem is accumulated from natural background. There were no measurable offsite radioactive effluent releases in CY77.

43583 **Radioactive plumes.** Kaiser, G.D. (UKAEA Reactor Group, Culcheth). pp 573-576 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Vol. 2. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977).

Gaseous effluent released from a nuclear reactor may be buoyant for two reasons. It may be hot - in the category of accident designated PWR1, the rate of release of heat can be as high as 500 MW. The plume may also be self heating - several tens of megawatts of decay heat may be released to the atmosphere. The paper's treatment of plume rise is based on work by Briggs. The model of Gifford is modified. The termination of rise due to the following is discussed; mechanical turbulence; convective turbulence; meander; the decay of buoyancy in stable conditions; the presence of an overhead inversion. The rate of spread of the plume is calculated while and after it is rising using a 'top-hat' or Gaussian profile (the radius of which is determined by the plume rise mechanism) for the former, and an area source atmospheric dispersion model for the latter. The behavior of a plume emitted into a building wake, with particular reference to the problem of lift-off, is also described. It is shown that: the duration of the release is critical in determining whether lift-off and/or substantial plume rise occur; the mechanisms that terminate plume rise all tend to reduce the potential benefits; plume rise can make a substantial difference to concentrations observed close to the source; there are circumstances in which plume rise can increase the ground level concentrations observed at large distances from the source. A brief discussion of outstanding problems is included; among these are the escape of gamma rays from the confines of the plume and uncertainties in the treatment of lift-off.

43584 **Method of evaluation of long range atmospheric transfers (100-1000 km).** Le Grand, J.; Despres, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Protection Sanitaire). pp 607-610 of Proceedings of the 4. International congress of the International Radiation Protection Association. Volume 2. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977). (In French)

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

A model of atmospheric transfer was developed in order to assess long-range consequences of normal or accidental gaseous releases from a nuclear plant. This study includes two parts: the determination of the trajectories of effluent plume over western Europe and the calculations of mean concentrations in every area of a grid map of the region. The plume trajectory is defined on the basis of average wind between 750 to 1000 mbar isobares. The components of this average wind are supplied by the Office National de Meteorologie, every 12 h during 2 years for 400 points of the meteorological forecast grid map. In the plant vicinity, correction factors take into account wind variations as a function of altitude. The calculation of mean concentrations in every grid area are founded on assumptions on horizontal and vertical diffusion processes. The preliminary results concerning continuous releases from a point source are presented.

43585 **Use of trajectory models for evaluation of the dispersion of airborne radioactivity in nuclear power plant accident situations.** Nordlund, G.G. (Finnish Meteorological Inst., Helsinki). pp 601-602 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Vol. 2. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977).

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

For rapid evaluation of the spread of radioactive material in connection with a muclear power plant accident, diagrams and tables are usually available. In recent times the use of computer-based systems for this evaluation has increased. However, in most cases a simple Gaussian-type dispersion model is still put into the computer. Since the influence of the accident should be calculated up to distances of several hundred kilometers, the assumption of homogeneous dispersion conditions of the whole area is not acceptable. In puff-type models such an unrealistic assumption is not needed and therefore this type of models is recommended. In the safety system set up by the Finnish Meteorological Institute a puff-type model is used. The presentation will consist of an explanation and discussion of this system.

SITE RESOURCE AND USE STUDIES

43586 (AD-A—045464) **Air quality impact of aircraft at 10 USAF bases. Final report, 25 September 1976—15 March 1977.** Naugle, D.F.; Grams, B.C. III; Daley, P.S. (Civil and Environmental Engineering Development Office, Tyndall AFB, Fla. (USA). Detachment 1 (ADTC)). Apr 1977. 17p. (CEEDO-TR—76-23). NTIS PCA02/MF A01.

The contributions of Air Force aircraft to ambient air quality at 10 major bases were predicted from operational data using a computerized Gaussian dispersion technique. Annual arithmetic mean concentrations are presented for common air pollutants. The predictions are well below National Ambient Air Quality Standards for those pollutants with standards specified as annual averages. Hourly worst case predictions were converted to Pollutant Standards Index (PSI) values. Aircraft sources produced average PSI values of 4.9 for nitrogen dioxide, 2.1 carbon monoxide, 1.9 for total suspended particulates, and 1.4 for sulfur dioxide. The PSI scale ranges from 0 to 500 with 100 designated as the level above which health effects may occur. A PSI for hydrocarbons could not be

computed since direct health effects have not been observed and indirect effects through oxidant formation could not be predicted within the scope of this analysis. The relative significance of pollutants emitted by AF aircraft indicated by this report is (from most significant to least significant); hydrocarbons, oxides, or nitrogen, particulate matter, carbon monoxide, and sulfur oxides. The ordering can be used as a guide to future design priorities and control strategy development.

REGULATIONS

REFER ALSO TO CITATION(S) 43069, 43562, 43563, 43564

43587 (N—78-11533) **Books on air pollution, noise and solid wastes.** (Centre National de Documentation Scientifique et Technique, Brussels (Belgium)). 1976. 153p. NTIS PC A08/MF A01.

Over 1000 full references to books, monographs, and reports in the field of air pollution, noise, solid waste, and environmental legislation are given together with subject and author indexes.

43588 (PB—273785) **Ranked input and output data used to determine impact of new source performance standards for particulate matter, nitrogen oxides, and sulfur oxides. Final task report, July 1974—July 1976.** Hopper, T.G.; Marrone, W.A. (Research Corp. of New England, Wethersfield, Conn. (USA)). Apr 1977. Contract EPA-68-02-1382. 641p. NTIS PC A99/MF A01.

The purpose of this document is to present the results of a study to determine the impact of new source performance standards on nationwide emissions. The work presented covers 14 potential pollutants from approximately 200 source categories for the year 1985. The results are being used by EPA as input to the development of an overall standard setting strategy. The report contains information regarding controlled and uncontrolled emission factors, State emission limitations, industrial capacity, utilization, growth and retirement rates. The results of this study have been published as three volumes which encompass ten separate documents. This document contains Appendices D through G of Volume III.

43589 (PB—275164) **Municipal incinerator enforcement manual.** Hopper, T.G. (Research Corp. of New England, Wethersfield, Conn. (USA)). Jan 1977. Contract EPA-68-01-3173. 125p. NTIS PC A06/MF A01.

This manual provides technical information to assist enforcement personnel at both state and federal levels in initiating actions to effect compliance by municipal incinerators with State Implementation Plan requirements. In addition to information pertaining to size, process, control equipment, and probable compliance status of the 108 municipal incinerators currently operating within the 48 contiguous states, this manual lists the appropriate emission limitations for each state and discusses methods of incinerating municipal waste and controlling the consequent air pollution.

43590 (PB—275652) **Standards of performance for new stationary sources: a compilation as of August 1976. Final report.** (PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio (USA)). Aug 1976. Contract EPA-68-02-1375. 340p. NTIS PC A15/MF A01.

This manual presents a compilation of the Environmental Protection Agency Standards of Performance for New Stationary Sources. Since their inception in 1971, the Standards of Performance for New Stationary Sources, commonly referred to as New Source Performance Standards or NSPS, have undergone considerable expansion and revision. This manual is intended to serve as a convenient reference and source of current information to those persons who will be working with the NSPS regulations. The manual includes: the full text of the standards as they appear now (August 1, 1976) with all revisions, corrections, and additions added where applicable, a summary of the emission standards for each source category covered under NSPS, and the full text of all revisions and other Federal Register notices pertaining to the standards. (Portions of this document are not fully legible)

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 43081

BASIC STUDIES

43591 (BNL—50775) **1977 breeding bird censuses and vegetation surveys in two successional stages of oak—pine forest.** Raynor, G.S.; Ruscica, J.J.; Clinton, J.H.; Larsen, D.L. (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1977. Contract EY-76-C-02-0016. 28p. Dep. NTIS, PC A03/MF A01.

As part of a program to characterize the plant and animal life of the Laboratory site and surrounding areas, two breeding bird census plots were established in 1977 to document the occurrence and abundance of breeding species in two extreme successional stages of Long Island oak-pine forest. A 9.3-hectare plot located near the northeastern corner of the Laboratory site is composed of second growth oak-pine forest in a late successional stage. The second plot measures 9.7 hectares and is located in the scrub oak-pitch pine barrens at Westhampton. Each plot was surveyed with a transit and steel tape and marked with wooden stakes at 100-foot intervals. Quantitative vegetational surveys were made in each plot and all plant species identified. Tree composition was measured as a function of species and size. Shrub density, percent of ground cover and percent of canopy were also measured. The Laboratory plot contained 2100 trees of five species per hectare, 72% ground cover and 84% canopy coverage. The Westhampton plot contained only one tree species, Pitch Pine, at 366 trees per hectare, 92% ground cover and no canopy. Twelve census trips, mostly of two to three hour duration, were made in each plot. Each bird observed was located on a scale map of the plot. At the end of the season, the number of territories was determined from the distribution of sightings. Eighteen territorial bird species were found in the Laboratory plot with between 479 and 629 territorial males per km^2. In Westhampton, only five breeding species were present. Density was between 312 and 374 males per km^2. The Rufous-sided Towhee was the most common species in both plots. Future studies will document changes in both bird and plant species composition and abundance.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42286, 43356, 43718

43592 (PB—272973) **Prevalence of subsurface migration of hazardous chemical substances at selected industrial waste land disposal sites. Final report.** Miller, D.W.; Braids, O.C.; Walker, W.H. (Garaghty and Miller, Inc., Port Washington, N.Y. (USA)). Sep 1977. Contract EPA-68-01-3703. 529p. NTIS PC A23/MF A01.

The purpose of the investigation was to determine the prevalence of subsurface migration of hazardous chemical constituents at 50 land disposal sites that had received large volumes of industrial wastes. The facilities include landfills, lagoons, and combinations of the two, both active and abandoned. They are located in 11 states in the humid region, east of the Mississippi River. Hazardous substances include (1) heavy metals other than iron and manganese, (2) cyanide, arsenic, and selenium, (3) organic substances as determined by gas chromatography. At 43 of the 50 sites migration of one or more hazardous constituents was confirmed. Migration of heavy metals was confirmed at 40 sites; selenium, arsenic and/or cyanide at 30 sites; and organic chemicals at 27 sites. Eighty-six wells and springs used for monitoring yielded water containing one or more hazardous substances with concentrations above background.

43593 **Frontal movement of aqueous solutions during redistribution through air-dry sand columns as a function of column length and time.** Rouston, R.C.; Brown, D.J. (Pacific Northwest Labs., Richland, WA). *Soil Sci.;* **125**: No. 5, 320-325(May 1978).

The frontal movement during redistribution of unsorbed waste fronts through an air-dried sand was measured as a function of time and column length for columns from 25 to 200 cm long. All column data fit an equation of the form S = ET/sup F/ . S was found to be significantly correlated with T (at the 1 percent level). The equation was normalized by dividing S and E by the column length. When this was done, data for all columns fit a single normalized equation. Use of this equation allows estimation of the shortest possible time necessary for the front of a pulse of waste solution to reach a given depth in a homogeneous soil system.

43594 **Selenium content of some foodstuffs and other environmental samples in a mineralized area of Italy.** Bombace, M.A.; Rossi, L.C.; Clemente, G.F. *Environ. Qual. Saf.;* **5**: 122-129(1976).

In order to get some information about concentration and distribution of Se in the environment and in the food-chain, a survey has been made of the air in an Italian area widely mineralized (e.g., Fe, Sb and particularly Hg). The Se content was determined by nondistructive neutron activation analysis and a large volume high-resolution Ge(Li) gamma ray spectrometer connected on-line to a DEC PDP 8/L computer. The Se concentration was determined in foodstuffs and environmental samples. Average Se intake for the population was also estimated and discussed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42386

SOIL

REFER ALSO TO CITATION(S) 42378, 43593

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

43595 (ORNL—5411) **Carcinogenic risk of lead-210 and polonium-210 in tobacco smoke: a selected, annotated bibliography.** Travis, C.C.; Etnier, E.L.; Kirkscey, K.A. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

This bibliography is concerned with the possible carcinogenic risk to man from the presence of lead-210 and polonium-210 in tobacco smoke. It includes a data base on such topics as background levels of lead-210 and polonium-210 in tobacco and tobacco smoke, tobacco plant uptake of lead-210 and polonium-210 from soil, metabolic models, and dose estimates. This data base should be of interest to those concerned with assessing the health effects resulting from the emanation of radan-222 from natural and technologically enhanced sources.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 42169, 42181, 42190

43596 (CONF-7608111—) **Proceedings of the environmental management of the coastal zone conference.** (Drexel Univ., Philadelphia, Pa. (USA)). 1976. 194p. Drexel Univ., Philadelphia, PA.

From Environmental management of the coastal zone conference; Philadelphia, PA, USA (9 Aug 1976).

Environmental factors to be considered in planning land use of the Atlantic coastal area discussed include: geological processes, sediment movement; wind waves, tides, and salinity gradients; land use on barrier beaches; offshore drilling during the construction of deepwater parts; offshore drilling of oil wells; fossil-fuel and nuclear power plants of coastal areas; environmental considerations of licensing floating nuclear plants; offshore dredging; marine disposal of sewage sludge and other municipal wastes; oil spills; hurricane modifications of coastal areas; and legal aspects of coastal zone management.

REGULATIONS

REFER ALSO TO CITATION(S) 43587

43597 (PB—275372) **State of Massachusetts Coastal Management draft environmental impact statement.** (Federal Office of Coastal Zone Management, Washington, D.C. (USA)). 1977. 148p. NTIS PC A07/MF A01.

Approval and implementation of the Massachusetts Coastal Management program will allow the state to better coordinate and more effectively implement existing state authorities for management of its coastal zone. The state will condition, restrict, or prohibit land and water uses in some parts of the Massachusetts coast, while encouraging development in other parts. Each coastal municipality will retain primary responsibility for managing land use along its coast. The impacts of the Massachusetts Coastal Zone Management program will be generally beneficial, although there may be some adverse, short-term economic impacts on coastal users, and the program will entail irreversible commitment of some coastal resources. The Massachusetts Coastal Management Program will produce positive and negative impacts.

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 43081

BASIC STUDIES

REFER ALSO TO CITATION(S) 42571

43598 (PB—273259) **Consequences of new energy patterns. Final report 1970-76.** Fishbein, L. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 39p. NTIS PC A03/MF A01.

The major objective of this overview is to briefly highlight the potential problem areas and research needs as a consequence of new energy patterns impacting on the nation's water sources and quality. In terms of trends in energy demand, it is important to stress the dramatically increased use of electricity. Studies on coal, oil, nuclear energy, geothermal energy and oil shale are covered. (Portions of this document are not fully legible)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42182, 42183, 42190, 42255, 42256, 42257, 42286, 43606, 43718

43599 (BNWL—2100(Pt.4), pp 62-65) **Environmental pollution analysis: instruments and methods development.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

Assessment of energy related pollutants at their sources and in effluents transported through the environment calls for ultrasensitive and reliable analytical instruments and methods. Analysis methods have been developed for measurement of the chemical forms and quantities of priority pollutant elements including: (1) As, Sb and Se in fresh, geothermal and sea waters by precipitation and x-ray fluorescence; (2) Hg in environmental waters by amalgamation and flameless atomic absorption; and (3) Cu, Pb and Cd in sea water by direct anodic stripping voltammetry using custom and commercial electrodes. New methods for x-ray fluorescence matrix corrections and data reduction also provide new capabilities for accurate multielement analyses of solid samples without requiring matching standards.

43600 (CONF-771236—(Absts.)) **Workshop on copper in estuarine, continental, and marine waters.** (Department of Energy, Washington, D.C. (USA). Div. of Biomedical and Environmental Research). Apr 1978. Contract EY-76-C-06-1830. 34p. Dep. NTIS, PC A03/MF A01.

From Conference on copper and estuarine continental and marine water; San Francisco, CA, USA (7 Dec 1977).

Abstracts of 34 papers are included that discuss the organic and inorganic complex forms of Cu in seawater, adsorption and desorption phenomena that affect the distribution and fate of Cu in estuarine and coastal waters and its availability to the biological components of marine ecosystems, and the potential impact of Cu on biological productivity and man. Results are reported of studies of US Atlantic and Pacific coastal waters, including subarctic fjords. Methods are described for the separation of Cu from seawater and for the chemical determination of Cu in saline water, including bacterial bioassay, neutron activation, and the use of ion selective electrodes. The influence of environmental factors on Cu accumulation by marine organisms, the biological availability of sediment-bound Cu, and the toxicity of Cu in marine organisms, with emphasis on molluscs, are discussed.

43601 (PB—273028) **Water quality of selected streams in the coal area of southeastern Montana. Water-resources investigations (final).** Knapton, J.R.; McKinley, P.W. (Geological Survey, Helena, Mont. (USA); Bureau of Land Management, Washington, D.C. (USA); Environmental Protection Agency, Washington, D.C. (USA)). Aug 1977. 156p. (USGS/WRD/WRI—77/062; USGS/WRI—77-80). NTIS PC A08/MF A01.

This report summarizes and evaluates water-quality data collected at 35 stream sites in the coal region of southeastern Montana. Sarpy Creek, Armells Creek, and Rosebud Creek sometimes have dissolved-solids concentrations that cause water to be marginal for agricultural purposes. At times of rainfall and snowmelt, the runoff water mixes with the base-flow component to improve the overall quality. Water in the Tongue River generally showed a downstream degradation in which some changes were related to the lithology of the aquifers contributing water to streamflow. Water from Pumpkin Creek and Mizpah Creek is used mostly for cattle watering. To some extent water is used for irrigation although the salinity hazard was often high. The chemical quality of the Powder River changed little during flow downstream. High sediment loads of the river acted as transporting agents for many of the plant nutrients and trace-element constituents.

43602 (PB—273349) **Monitoring to detect previously unrecognized pollutants in surface waters. Final report.** Ewing, B.B.; Chian, E.S.K.; Cook, J.C.; Evans, C.A.; Hopke, P.K. (Illinois Univ., Urbana (USA). Inst. for Environmental Studies). Jul 1977. Contract EPA-68-01-3234. 84p. NTIS PC A05/MF A01.

Contents: Introduction--(Background and Objectives, Organization, and Sample Collection and Analysis Schedule); Site selection, sample collection, and gross analysis--(Site Selection, Sample Collection, and Gross Analysis); Sample preparation--(Stripping Procedures, Liquid-liquid Extraction, and Sorptive Extraction Technique); Inorganic analysis--(Spark-source Mass Spectral Analysis, Instrumental Neutron Activation Analysis, and Energy-dispersive X-ray Fluorescence Analysis); Organic analysis--(Identification of Organics, Quantitation of Organics, and Summary of the Organic Compounds Found).

43603 (PB—273350) **Monitoring to detect previously unrecognized pollutants in surface waters--appendix: organic analysis data. Appendix to final report.** Ewing, B.B.; Chian, E.S.K.; Cook, J.C.; Evans, C.A.; Hopke, P.K. (Illinois Univ., Urbana (USA). Inst. for Environmental Studies). Jul 1977. Contract EPA-68-01-3234. 304p. NTIS PC A14/MF A01.

Samples of surface waters were collected from 204 sites near heavily industrialized areas across the United States. The samples were analyzed for all contaminants present at concentrations greater than one part per billion. Each water sample was preconcentrated for analysis of organics in three fractions: volatile organics by nitrogen-gas stripping and the less-volatile organics by extraction with chloroform under both basic and acidic conditions. Organic constituents were identified by gas chromatography/mass spectrometry and quantified by gas-chromatographic techniques. Inorganic constituents were determined by spark-source mass spectrometry, energy-dispersive x-ray fluorescence analysis, and instrumental neutron activation analysis. For comparison with previous data from the same sites, the samples were also analyzed for total chemical oxygen demand, turbidity, conductivity, pH, color, oxidation-reduction potential, suspended solids, and volatile suspended solids. Results of the inorganic analyses were presented in previous quarterly progress reports. Final results of the organic analyses are presented in this appendix to the final report.

43604 (UCRL—13848) **Reproduction and survival of the pileworm Nereis succinea in higher Salton Sea salinities.** Oglesby, L.C. (Pomona Coll., Claremont, Calif. (USA)). 1977. 43p. Dep. NTIS, PC A03/MF A01.

It is the purpose of the present study to establish the upper salinity limits for reproduction and survival of the pileworm N. succinea in Salton Sea waters, in order to assess the possibility that pileworm failure due to increased salinity may adversely affect the sportfishery, which depends upon the pileworms for food.

43605 Mass spectrometric analysis of process streams for coal-derived fuels. Sharkey, A.G. Jr. (Pittsburgh Energy Research Center). pp 341-347 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

This summary indicates the extensive role that mass spectrometry is now playing in the analysis of coal hydrogenation and coal gasification products. Many of the techniques required can be carried over from established methods for the analysis of petroleum products. Major deficiencies in the above-described analytical scheme, wherein mass spectrometry could play a major role in the future, include devising a routine technique for the analysis of the product oil to evaluate operating parameters, and expanding research to devise techniques for evaluating environmental concerns.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 43579

43606 Use of ^{210}Pb as a heavy metal tracer in the Susquehanna River system. Lewis, D.M. (Yale Univ., New Haven). *Geochim. Cosmochim. Acta;* **41**: No. 11, 1557-1564(Nov 1977).

Analysis of soil profiles and shallow ground water in the Susquehanna River basin, northeastern U.S.A., indicates that the atmospheric flux of ^{210}Pb is efficiently scavenged by the organic-rich horizons of the soils. This atmospherically supplied ^{210}Pb in soil profiles can only be lost from the system by soil erosion. Based on the annual sediment yield of the Susquehanna River and the excess ^{210}Pb concentration in particulate matter, a mean residence time of 2000 y is calculated for metals similar to Pb in soil profiles. The West Branch of the Susquehanna River (WBSR) is strongly affected by acid mine drainage and is low in pH and high in dissolved (less than 0.4 μm) ^{210}Pb, Fe, and Mn. Along its course iron hydroxide is precipitating at a PH of between 4 and 4.5, and the ^{210}Pb supplied by the acid mine water is diminished by about 25 percent as a result of dilution. As the WBSR enters the Valley and Ridge Province of the Appalachians it has a ^{210}Pb concentration of approximately 0.2 dpm/l. At this juncture it receives a considerable influx of alkalinity from tributaries draining carbonate terranes, resulting in neutralization of the sulfuric acid and increase of the river pH to around 6.5-7. This ph adjustment is accompanied by the precipitation of Fe and Mn. Due to the slow rate of Mn removal from solution, the Mn precipitation extends a considerable distance down river from the point of acid neutralization. Analyses for ^{210}Pb in the river at points in or below the region of Mn precipitation show that ^{210}Pb is rapidly scavenged from solution onto suspended particles. From the data it is possible to calculate the removal rate of Pb from water in the presence of Fe and Mn hydroxides and other particles. At a pH of 4-4.5 Pb removal is nonexistent relative to the river flow rate, but at a pH of 6.5-7 the ^{210}Pb data indicate a residence time of less than 0.7 day for dissolved Pb.

WATER

REFER ALSO TO CITATION(S) 42357, 42363

43607 (UCRL—13843-1) **Statistical approach to modeling transport of pollutants in groundwater.** Ross, B.; Koplik, C.M.; Crawford, B.S. (Analytic Sciences Corp., Reading, Mass. (USA)). 1978. Contract W-7405-ENG-48. 33p. Dep. NTIS, PC A03/MF A01.

The transport of pollutants in the subsurface can be affected by random geologic events. Prediction of such transport therefore requires solution of a partial differential equation whose coefficients are random processes. A method of finding the expected (mean) values of solutions of such equations is derived. This method is used to assess the impact of fault movement and formation of breccia pipes on risk from radioactive waste disposal. Preliminary results indicate that these events, considered probabilistically, do not make a large contribution to risk.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

43608 (PB—273512) **Physical, chemical, and biological relations of four ponds in the Hidden Water Creek strip-mine area, Powder River Basin, Wyoming. Preliminary report.** Wangsness, D.J. (Geological Survey, Cheyenne, Wyo. (USA). Water Resources Div.). Jul 1977. 48p. (USGS/WRD/WRI—77/072; USGS/WRI—77-72). NTIS PC A04/MF A01.

The Hidden Water Creek area was mined from 1944 to 1955 and was then abandoned. The open pits filled with water and pond-type ecosystems developed. Light was transmitted to greater depths within two control ponds located outside the mine area. The lower light transmittance in the ponds within the mined area probably was due, in part, to the greater number of phytoplankton cells. Also, unconsolidated soil material within the mine area was observed to slough off the pond banks, which could add to the concentration of suspended sediments. Dissolved oxygen concentrations were lower in the ponds within the mined area. Most of the major ions (calcium, magnesium, sulfate, and sodium) were present in greater concentrations in the ponds within the mined area. Higher concentrations of bicarbonate and total hardness were measured in the water within the mined area. Biological communities were less diverse and chemical concentrations fluctuated more in the mined area than in the ponds outside the mined area.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 42183, 43596

43609 (EPRI-EA—790-SY) **Water supply data base system.** Nunamaker, J.F. Jr.; Pingry, D.E. (Arizona Univ., Tucson (USA)). May 1978. 17p. Dep. NTIS, PC A02/MF A01.

This is a summary report for RP762, "Water Supply Data Base". The result of this study is a data base or "data dictionary" describing water data collection efforts. This data system has two components, a "macro" data base and a "micro" data base. The macro data base contains overview information concerning regions, organizations and data sets and their interrelationship. The micro data base contains the detailed structure of each data set, information describing each and method of accessibiliy. Data sets containing national and Colorado River Basin specific data are included. These data bases are currently installed on a commercial computer which is accessible through a national communication network.

REGULATIONS

REFER ALSO TO CITATION(S) 43069

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 43066, 43070, 43071, 43072, 43073, 43074, 43075, 43078, 43096, 43126, 43613, 43614

43610 (PB—275154) **Examination of the moral dilemmas of university scientists participating in the preparation of environmental impact statements. Final report 1 Jul 76-31 Oct 77.** Matzke, G. (Oklahoma State Univ., Stillwater (USA). Dept. of Geography). 19 Sep 1977. 274p. NTIS PC A12/MF A01.

The report focuses on the value implications for society of participation in the preparation of environmental impact (EI) documents, in response to National Environmental Policy Act requirements. Chapter 1 outlines the research scope and design and summarizes relevant aspects of the three focal case-study projects. Chapter 2 focuses on the value-patterns and implicit value judgments reflected in the case study EI documents. Chapter three considers the value orientations of the participating scientists, using materials gathered from interviews with them. Chapter 4 relates research findings to broader issues of science values, including the scientific merits and status of EI work, scientific responsibility in EI work, influence of discipline on questions of scientific quality, and perceived effectiveness of the EI process in protecting the environment. In Chapter 5, the relevance and shortcomings of a published code of ethics for environmental professionals is examined in light of the case studies.

43611 (PB—275256) **Evaluation of the regional activities model (ram) developed at the Center for the Environment and Man, Inc. Final report.** Frendewey, J.O. Jr.; Monarchi, D.E.; Taylor, R.H. (Colorado Univ., Boulder (USA). Business Research Div.). 15 Oct 1977. 49p. NTIS PC A03/MF A01.

The Regional Activities Model (RAM) was developed for the purpose of analyzing the economic and environmental impacts on a region due to population, employment, manufacturing, commerce, and service industries. The impact of four other energy-consuming activities also are analyzed: space heating, electric power generation, vehicle-miles-of-travel, and incineration. The levels of these activities are then used to determine the amount of pollutants (residuals) that would be generated within the region being investigated. This report presents an evaluation of the RAM and its associated models based upon computer runs on the CDC 6400 computer at the University of Colorado, using test data supplied by CEM, and also using Colorado specific data.

43612 (SAN—1379-1) **Socioeconomic impact mitigation mechanisms in six states: categories, generalizations, and unresolved issues.** Gilmore, J.S.; Flory, D.K.; Hammond, D.M.; Moore, K.D.; Coddington, D.C. (Denver Research Inst., Colo. (USA); Bickert, Browne, Coddington and Associates, Inc., Denver, Colo. (USA)). Sep 1977. Contract EX-77-C-03-1379. 176p. Dep. NTIS, PC A09/MF A01.

The perceptions of socioeconomic impacts from energy development held by state officials in Colorado, Illinois, Kentucky, Louisiana, Massachusetts, and Montana are examined. Impacts are categorized and related impact mitigation mechanisms are reviewed. The report is designed to serve as a resource paper for a conference dealing with impact mitigation policy and implementation. Since negative socioeconomic impacts may impinge upon energy development and substitution activities, the report may also serve as a basis of discussion of this aspect of energy policy implementation.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 43066, 43073, 43598

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 42249, 42250, 42251, 43132

43613 (PB—274680) **Guidebook for regional and state environmental analysis of projects in Appalachia. Volume I. Guidebook and ARC role. Final report.** (Messer Associates, Inc., Silver Spring, Md. (USA); Rivkin Associates, Inc., Washington, D.C. (USA)). Aug 1977. 503p. NTIS PC A22/MF A01.

This guidebook for regional and state environmental analysis of projects in Appalachia was prepared for the Energy, Environment, and Natural Resources Division of The Appalachian Regional Commission. The entire effort has been divided into two major components. Volume I is the Guidebook and ARC Role for conducting environmental analyses for energy-related projects in Appalachia. Volume II presents Case Studies for 15 energy-related projects in Appalachia, demonstrating the decision-making process (including the environmental impact statement preparation process) that took place for those projects. The types of energy-related projects discussed in this guidebook are power plants, coal mining and coal refining, and water resources. The guidebook is organized into the following chapters and appendices: Procedural guidelines for environmental impact statement preparation and review; environmental impacts; environmental components--methods for baseline and impact analysis; the current role of environmental impact analysis within the planning framework of The Appalachian Regional Commission; and proposed options for ARC requirements for NEPA compliance. (Portions of this document are not fully legible)

43614 (PB—274681) **Guidebook for regional and state environmental analysis of projects in Appalachia. Volume II. Case studies. Final report.** (Messer Associates, Inc., Silver Spring, Md. (USA); Rivkin Associates, Inc., Washington, D.C. (USA)). Aug 1977. 241p. NTIS PC A11/MF A01.

This guidebook for regional and state environmental analysis of projects in Appalachia was prepared for the Energy, Environment, and Natural Resources Division of The Appalachian Regional Commission. The entire effort has been divided into two major components. Volume II presents Case Studies for 15 energy-related projects in Appalachia, demonstrating the decision-making process (including the environmental impact statement preparation process) that took place for those projects. These projects include: Pleasants Power Station, units 1 and 2, Pleasants County, West Virginia; Tombigbee Power Station, units 2 and 3, Washington County, Alabama; Hartsville Nuclear Power Plants, Smith and Trousdale Counties, Tennessee; Blue Ridge Power Station, New River, Virginia; Homer City Coal Gasification Pilot Plant, Indiana County, Pennsylvania; Solvent Coal Refining Demonstration Project, Shelby County, Alabama; Laurel Run Reclamation Project, Preston County, West Virginia; Cherry Creek Mine Reclamation and Abatement Project, Garrett County, Maryland; Moraine State Park Reclamation Project, Butler County, Pennsylvania; Helen Wastewater Treatment Facility, Helen, Georgia; Tennessee-Tombigbee Waterway, Alabama, Mississippi, Tennessee; Appalachian Corridor Clarksburg Expressway to I-79, West Virginia; Appalachian Corridor 'A' Extension of State Route 400; Yellow Creek Port Project, Tishomingo County, Mississippi; and Nashville Thermal Transfer, Nashville, Tennessee.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 43591

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 43658, 43660, 43676, 43680, 43722

43615 (CONF-780433—2) **Proteolytic inactivation and coordinate protection of the AROM enzyme conjugate of neurospora.** Vitto, A.; Gaertner, F.H. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From Conference on limited proteolysis in microorganisms; Washington, DC, USA (17 Apr 1978).

The arom enzyme system of Neurospora crassa is a pentafunctional enzyme conjugate which catalyzes five steps in the synthesis of the aromatic amino acids. The occurrence of five enzymes on a single polypeptide chain has provided a unique opportunity to examine the response of a multi-domained protein structure to limited proteolytic attack.

43616 (CONF-780446—1) **Reactive phosphate esters as affinity labels for enzymes of carbohydrate metabolism.** Hartman, F.C.; Norton, I.L.; Stringer, C.D.; Schloss, J.V. (Oak Ridge National Lab., Tenn. (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1978. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

From Workshop on affinity techniques; Goettingen, F.R. Germany (10 Apr 1978).

Many enzymes of carbohydrate metabolism have an affinity for small organic anions. An attempt was made to exploit the common binding specificities of enzymes, whose substrates are phos-

phate esters, in the design and use of affinity labels. The basic premise is that small phosphate esters that contain chemically reactive substituents will be active-site-specific probes for some enzymes with affinities for phosphate esters. This paper describes three recent endeavors: (1) an attempt to design an affinity label for the catalytic group of triosephosphate isomerase that polarizes the substrate carbonyl, (2) the use of N-bromoacetylethanolamine phosphate (BrAcNHEtOP) as an affinity label for rabbit and chicken phosphoglycerate mutase, and (3) the use of BrAcNHEtOP as an affinity label for D-ribulose 1,5-bisphosphate carboxylase/oxygenase.

43617 Fluorescence-quenching study of glucose binding by yeast hexokinase isoenzymes. Feldman, I.; Kramp, D.C. (Univ. of Rochester, NY). *Biochemistry;* **17**: No. 8, 1541-1547(18 Apr 1978).

A study of the effect of varying ionic strength on the glucose-induced quenching of tryptophan fluorescence of hexokinase isoenzymes A(P-I) and B(P-II) was carried out at pH 8.3 and pH 5.5. At pH 8.3 both isoenzymes gave apparently linear Scatchard-type data plots even with protein concentrations and ionic strengths for which both dimeric and monomeric forms of hexokinase coexist in significant amounts. Taking into account a 1 percent accuracy in the experimental measurements, we concluded that the intrinsic dissociation constants, K/sub M/ and K/sub D/, for the binding of glucose to the monomeric and dimeric forms of HkB, are within a factor of two of each other, i.e., K/sub D//K/sub M/ equal to or less than 2. The values of K/sub M/, estimated from the apparent K, were so greatly influenced by ionic strength that it is clear that it is meaningless to compare K/sub M/ and K/sub D/ values measured at different ionic strengths as has been done in the literature. Curvature in the pH 5.5 fluorescence-quenching plots for relatively low ionic strengths demonstrates cooperativity for glucose-binding to the dimer, positive for HkA but negative for HkB. In contrast, the binding is relatively noncooperative at high ionic strength at this pH. These results were attributed to the well known effect of salt-neutralization of side chain electrical charges on the flexibility and compactness of proteins.

43618 Electronic state of heme in cytochrome oxidase. II. Oxidation-reduction potential interactions and heme iron spin state behavior observed in reductive titrations. Babcock, G.T.; Vickery, L.E.; Palmer, G. (Michigan State Univ., East Lansing). *J. Biol. Chem.;* **253**: No. 7, 2400-2411(10 Apr 1978).

Magnetic circular dichroism (MCD), electron paramagnetic resonance (EPR), and optical absorption spectroscopies have been used to monitor the concentrations of oxidized and reduced heme and copper during stoichiometric reductive titrations of purified beef heart cytochrome oxidase. The MCD data are deconvoluted to obtain the concentrations of reduced cytochromes a and a_3 during the titrations; analysis of the EPR spectra provides complementary data. For the native enzyme in the absence of exogenous ligands, cytochromes a and a_3 are reduced to approximately the same extent at all points in the titration. The reduction of the EPR-detectable copper initially lags the reduction of the two cytochromes but in the final stages of the titration is completely reduced prior to either cytochrome a or a_3. These results are interpreted to indicate that the primary mode of heme-heme interaction in cytochrome oxidase involves shifts in oxidation-reduction potential for each of the two cytochromes such that a change in oxidation state for one of the hemes lowers the oxidation-reduction potential of the second heme by approximately 135 mV. Evidence is presented to indicate that at least some of these signals can be attributed to cytochrome a^{3+} which has undergone a low-spin to high-spin state transition in the course of the titration. In the presence of carbon monoxide the oxidation-reduction properties of cytochromes a and a_3 are markedly altered. The $a_3{}^{2+}$. CO complex is fully formed prior to reduction of either cytochrome a^{3+} or the EPR-detectable copper. The g = 3 EPR signal attributed to cytochrome a^{3+} decreases as the MCD intensity of cytochrome a^{2+} increases.

43619 Kinetic studies of Escherichia coli transfer RNA (uracil-5-)-methyltransferase. Shugart, L. (Oak Ridge National Lab., TN). *Biochemistry;* **17**: No. 6, 1068-1072(21 Mar 1978).

The kinetic mechanism of a semipurified tRNA (uracil-5-)-methyltransferase (EC 2.1.1.35) preparation obtained from Escherichia coli has been studied at pH 9.0 in the presence and absence of products. The initial velocity and product inhibition patterns are consistent with a random order of addition of adenosylmethionine and transfer RNA to separate and independent binding sites on the enzyme. Values have been determined for the Michaelis and product inhibitor constants.

43620 Electron spin polarization in photosynthesis and the mechanism of electron transfer in photosystem. I. Experimental observations. Dismukes, G.C.; McGuire, A.; Blankenship, R.; Sauer, K. (Univ. of California, Berkeley). *Biophys. J.;* **21**: No. 3, 239-256(Mar 1978).

Transient electron paramagnetic response (EPR) methods are used to examine the spin populations of the light-induced radicals produced in spinach chloroplasts, photosystem I particles, and Chlorella pyrenoidosa. We observe both emission and enhanced absorption within the hyperfine structure of the EPR spectrum of $P700^+$, the photooxidized reaction-center chlorophyll radical (Signal I). By using flow gradients or magnetic fields to orient the chloroplasts in the Zeeman field, we are able to influence both the magnitude and sign of the spin polarization. Identification of the polarized radical and $P700^+$ is consistent with the effects of inhibitors, excitation light intensity and wavelength, redox potential, and fractionation of the membranes. The EPR signal of the polarized $P700^+$ radical displays a 30 percent narrower line width than $P700^+$ after spin relaxation. This suggests a magnetic interaction between $P700^+$ and its reduced (paramagnetic) acceptor, which leads to a collapse of the $P700^+$ hyperfine structure. Narrowing of the spectrum is evident only in the spectrum of polarized $P700^+$, because prompt electron transfer rapidly separates the radical pair. Evidence of cross-relaxation between the adjacent radicals suggests the existence of an exchange interaction.

43621 Purification and properties of a third form of anthranilate-5-phosphoribosylpyrophosphate phosphoribosyltransferase from the enterobacteriaceae. Largen, M.; Mills, S.E.; Rowe, J.; Yanofsky, C. (Univ. of California, San Diego). *J. Biol. Chem.;* **253**: No. 2, 409-412(25 Jan 1978).

Anthranilate-5-phosphoribosypyrophosphate phosphoribosyltransferase was purified from the bacterium Erwinia carotovora, a member of the Enterobacteriaceae. The enzyme was homogeneous according to the criteria of gel electrophoresis and NH_2-terminal amino acid sequence analysis. The molecular weight of the enzyme as determined on a calibrated Sephadex G-200 column was 67,000 +- 2,000. Sodium dodecyl sulfate-polyacrylamide gels gave a subunit molecular weight of 40,000 +- 1,000, suggesting that the enzyme was a dimer. A comparison of the NH_2-terminal sequence of the enzyme with the (previously determined) homologue from Serratia marcescens, a monomer with a molecular weight of 45,000, showed that the larger Serratia subunit came into register with amino acid 14 of the Erwinia subunit. The register for the length of the known overlap, 26 amino acids, was highly conserved.

43622 Sedimentation behavior of native and reduced apolipoprotein A-11 from human high density lipoproteins. Teng, T.L.; Barbeau, D.L.; Scanu, A.M. (Univ. of Chicago). *Biochemistry;* **17**: No. 1, 17-21(10 Jan 1978).

The solution properties of human serum apolipoprotein A-II, both in the native and in the reduced forms, were investigated by the technique of sedimentation equilibrium in the analytical ultracentrifuge. For both proteins, the apparent weight average molecular weights determined in neutral buffer systems were found to be dependent on protein concentration and invariant with the rotor speeds used (16,000 to 44,000 rpm) indicating a reversible self-association. These results were also found to be independent of temperature between 5 and 30°C. The pattern of self-association of native apolipoprotein A-II could best be described by a monomer-dimer-trimer equilibrium, in agreement with previously reported data (Vitello, L. B., and Scanu, A. M. (1976), Biochemistry 15, 1161). The self-association pattern of apolipoprotein A-II reduced in the presence of 50 mM dithiothreitol conformed with a monomer-dimer-tetramer equilibrium similar to that reported for the native single chain apolipoprotein A-II of the rhesus monkey (Barbeau, D. L., et al. (1977), J. Biol. Chem. 252, 6745), but differing significantly from that reported for the reduced and carboxymethylated human product (Osborne, J. C., et al. (1975), Biochemistry 14, 3741).

43623 Interconversion of conformational isomers of light chains in the Mcg immunoglobulins. Firca, J.R.; Ely, K.R.; Kremser, P.; Westholm, F.A.; Dorrington, K.J.; Edmundson, A.B. (Argonne National Lab., IL). *Biochemistry;* **17**: No. 1, 148-158(10 Jan 1978).

Previous crystallographic studies in this laboratory demonstrated that immunoglobulin light chains with the same amino acid sequence can have at least two and probably three or more conformations, depending on whether the second member of an interacting pair is a light or heavy chain. If a heavy chain is not available in the assembly medium, a second light chain plays the structural role of the heavy chain in the formation of a dimer. In the present work, the lambda-type light chains were dissociated from the heavy chains of a serum IgG1 immunoglobulin from the patient Mcg and reassembled noncovalently into a dimer. The reassembly process was completed by allowing the penultimate half-cystine residues to form an interchain disulfide bond. The covalently linked dimer was compared with the Mcg urinary Bence-Jones dimer, for which an atomic model has been fitted to a 2.3-A electron density map. The assembled dimer and the native Bence-Jones protein were indistinguishable in their chromatographic and electrophoretic properties, as well as in their activity in the binding of bis(dinitrophenyl)lysine. These results indicate that the light chains can be converted into the two types of Bence-Jones conformational isomers. The procedure was also reversed the two Bence-Jones isomers were dissociated and reassembled as the single type of isomer associating with each of two

heavy chains in the IgG1 protein. The change in activity occurring when a light chain associates with a heavy chain instead of a second light chain is illustrated by the fact that the Mcg IgG1 immunoglobulin does not bind bis(dinitrophenyl)lysine in measurable amounts.

43624 Crystal properties as indicators of conformational changes during ligand binding of interconversion of Mcg light chain isomers. Ely, K.R.; Firca, J.R.; Williams, K.J.; Abola, E.E.; Fenton, J.M.; Schiffer, M.; Panagiotopoulos, N.C.; Edmundson, A.B. (Argonne National Lab., IL). *Biochemistry;* **17**: No. 1, 158-167(10 Jan 1978).

Crystals were prepared from samples of nonjovalent and covalently linked dimers previously isolated as intermediates and end products in the interconversion of conformational isomers of immunoglobulin light chains from the patient Mcg. In ammonium sulfate these dimers crystallized in the trigonal form characteristic of the native Bence-Jones protein and in an abnormal needle form associated with conformational changes in the vicinity of the interchain disulfide bond. Trigonal forms were compared with the native covalent dimer by difference Fourier analysis at 3.5-A resolution. The packing of molecules in the trigonal crystal lattice was examined in detail to determine the steric limitations governing chemical modifications, chemical modifications within crystals or in solutions slated for crystallization. When the modifications involved only the cleavage and alkylation of the interchain disulfide bond, the difference Fourier maps indicated only local conformational changes mainly in the COOH-terminal pentapeptide segment of monomer 2 of the dimer. When light chains were dissociated from heavy chains and reassembled into a dimer, there were changes in segments which interact to stabilize the V domain dimer. These changes, as well as the more extensive changes in the needle forms, could be reversed by dissolving the crystals, cleaving the interchain disulfide bond, and allowing it to reoxidize. The resulting proteins crystallized as trigonal forms indistinguishable from those of the native dimer. After the binding of two molecules of bis(dinitrophenyl)lysine and subsequent removal of the ligands by dialysis, the dimer crystallized only as needles.

43625 Ultracentrifugal study of the self-association of canine apolipoprotein A-I in solution. Teng, T.L.; Edelstein, C.; Barbeau, D.L.; Scanu, A.M. (Univ. of Chicago). *J. Biol. Chem.;* **252**: No. 23, 8634-8638(10 Dec 1977).

The sedimentation behavior of canine apolipoprotein (apo) A-I in 0.02 m EDTA, pH 8.6, was studied as a function of protein concentration by the techniques of sedimentation velocity and sedimentation equilibrium in the analytical ultracentrifuge. At concentrations of less than 1 g/liter, apo-A-I exhibited a monomodal sedimentation pattern, with apparent sedimentation coefficients which varied from 2.3 to 3.5 S with increasing protein concentrations. Above 1.5 g/liter, apo-A-I had two well resolved peaks with S/sub 20,w/ values of 4.15 S and 5.75 S. The proportion of the 5.75 S component increased with increasing apo-A-I concentrations, with a concomitant decrease of the 4.15 S component. By sedimentation equilibrium ultracentrifugation with both the conventional and meniscus-depletion methods, the apparent weight-average molecular weight of apo-A-I was found to be concentration-dependent. At a protein concentration of 5.25 g/liter, an apparent weight average molecular weight of 138,000 was determined, indicating that molecular species larger than a tetramer (monomer molecular weight = 28,000) were present in solution. When analyzed in terms of a reversible self-associating system, the experimental data could best be described according to a monomer-dimer-tetramer-octamer model, as previously reported for human apo-A-I (Vitello, L. B., and Scanu, A. M. (1975) J. Biol. Chem. 251, 1131-1136). The equilibrium constants were: $K_2 = 4.5$ liters/g, $K_4 = 470$ liters^3/g^3, and $K_8 = 41{,}600$ liters^7/g^7, respectively.

43626 Endonuclease activity of venom phosphodiesterase specific for single-stranded and superhelical DNA. Pritchard, A.E.; Kowalski, D.; Laskowski, M. Sr. (Roswell Park Memorial Inst., Buffalo). *J. Biol. Chem.;* **252**: No. 23, 8652-8659(10 Dec 1977).

A homogeneous preparation of venom phosphodiesteraseus adamanteus possesses an intrinsic endonuclease activity, specific for superhelical (form I) and single-stranded DNA. The phosphodiesterase degrades single-stranded T_7 DNA by endonucleolytic cleavages. Duplex T_7 DNA is hydrolyzed by the liberation of acid-soluble products simultaneously from the 3′ and 5′ termini but without demonstrable internal scissions in duplex regions. Since venom phosphodiesterase is known to hydrolyze oligonucleotides stepwise from the 3′ termini, the cleavage at the 5′ end of duplex T_7 DNA is ascribed to an endonuclease activity. Form I PM2 DNA is nicked to yield first relaxed circles and then linear DNA which is subsequently hydrolyzed only from the chain termini. The linear duplex DNA intermediates consist of a discrete series of fragments (11 are usually resolved on agarose gels) with initial molecular weights ranging from 6.3×10^6 (the intact PM2 DNA size) to approximately 1×10^6. The cleavage of the form I molecule must, therefore, occur at a limited number of unique sites. The enzyme also cleaves nonsuperhelical, covalently closed circular PM2 DNA but at a 10^4 times slower rate. Both the endonuclease activity on form I DNA and the known exonuclease activity co-migrate on polyacrylamide gels, are optimally active at pH 9, are stimulated by small concentrations of Mg^{2+}, and are similarly inactivated by heat, reducing agents, and EDTA.

43627 Mechanism of T5-induced DNA polymerase. I. Replication of shortprimer templates. Das, S.K.; Fujimura, R.K. (Univ. of Tennessee, Oak Ridge). *J. Biol. Chem.;* **252**: No. 23, 8700-8707(10 Dec 1977).

Bacteriophage T5-induced DNA polymerase shows an initial phase of rapid synthesis, followed by a slower steady rate for much longer periods, with short DNA primer-templates (400 to 600 nucleotides long) in vitro. On extrapolating the line of steady rate back to 0 min, an intercept is obtained on the ordinate. With large DNA primer-templates, such as denatured T5 DNA (average chain length approximately 50,000 bases), the rate of synthesis remains constant and is equal to the initial rate obtained with short primer-templates. The zero time intercept was proportional to the amount of enzyme used and independent of temperature. Polymer challenge experiments indicate that the initial phase of rapid synthesis can be attributed to the processive mode of synthesis by T5 DNA polymerase. After synthesizing a stretch of DNA processively for about 200 nucleotide residues, the enzyme apparently forms a dead-end complex with the primer-templates used and must dissociate from the primer-template in order to resume synthesis. The average size of the product made processively, during various phases of synthesis, remains invariant and is in good agreement with the size of the zero time intercept per enzyme molecule.

43628 Mechanism of T5-induced DNA polymerase. II. Characterization of the dead-end complex. Das, S.K.; Fujimura, R.K. (Univ. of Tennessee, Oak Ridge). *J. Biol. Chem.;* **252**: No. 23, 8708-8712(10 Dec 1977).

We have shown that bacteriophage T5-induced DNA polymerase replicates short primer-templates (400 to 600 nucleotides long) at a rapid rate initially, followed by a slower rate sustained for much longer periods (Das, S. K., and Fujimura, R. K. (1977) J. Biol. Chem. 252, 8700-8707). In order to explain the slower steady rate and the results of polymer-challenge experiments, we conjectured the presence of a dead-end complex formed by the enzyme with the primer-template at the end of the primer elongation process. In this communication we present evidence which indicates that the presumed complex shows a first order kinetics of decay with a half-life of 3.5 min at 37°. Energies of activation for the steady phase of synthesis and the decay of the dead-end complex were both found to be about 23 kcal/mol. This indicates that the dissociation of the aforesaid complex might be the rate-limiting step during the steady phase of synthesis. Correlation between the salt-induced reduction in the half-life of the complex and the increase in the steady rate of synthesis is in agreement with the above mentioned possibility.

43629 Substrate and substrate analogue binding properties of Renilla luciferase. Matthews, J.C.; Hori, K.; Cormier, M.J. (Univ. of Georgia, Athens). *Biochemistry;* **16**: No. 24, 5217-5220(29 Nov 1977).

Luciferase from the anthozoan coelenterate Remilla reniformis catalyzes the oxidative decarboxylation of luciferin consuming 1 mol of O_2 per mol of luciferin oxidized and producing 1 mol of CO_2, 1 mol of oxyluciferin, and light (lambda/sub B/, 480 nm) with a 5.5 percent quantum yield. In this work we have examined the binding characteristics of luciferin, luciferin analogues, and competitive inhibitors of the luciferin-luciferase reaction. The results show that luciferin binding and orientation in the single luciferin binding site of luciferase are highly specific for and dependent upon the three group substituents of the luciferin molecule while the imidazolone-pyrazine nucleus of luciferin is not directly involved in binding. Anaerobic luciferin binding promotes a rapid concentration-dependent aggregation of luciferase which results in irreversible inactivation of the enzyme. This aggregation phenomenon is not observed upon binding of oxyluciferin, luciferyl sulfate, or luciferin analogues in which the substituent at the 2 position of the imidazolone-pyrazine ring has been substantially altered.

43630 X-ray absorption edge studies on oxidized and reduced cytochrome c oxidase. Hu, V.W. (California Inst. of Tech., Pasadena); Chan, S.I.; Brown, G.S. *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 9, 3821-3825(Sep 1977).

The x-ray absorption edge spectra of the Cu and Fe centers in oxidized and reduced cytochrome c oxidase (ferrocytochrome c : oxygen oxidoreductase; EC 1.9.3.1) have been obtained using synchrotron radiation from the SPEAR storage ring at the Stanford Linear Accelerator Center. In addition, ozidized and reduced plastocyanin as well as a number of model copper compounds in various oxidation states were also examined. A comparison of the absorption edge fine structure of cytochrome oxidase with those of the models indicates that one of the two coppers in the oxidized protein is in the +1 oxidation state. Upon reduction of the protein with dithionite, the second copper becomes Cu(I). The shift in the Fe K-edge of cytochrome oxidase upon reduction is small (about 2 eV or 3×10^{-19}

J) and is comparable to that previously observed for the reduction of the heme iron of cytochrome c.

43631 Dissociation of tumor promoter-stimulated ornithine decarboxylase activity and DNA synthesis in mouse epidermis in vivo and in vitro by fluocinolone acetonide, a tumor-promotion inhibitor. Lichti, U. (National Cancer Inst., Bethesda, MD); Slaga, T.J.; Ben, T.; Patterson, E.; Hennings, H.; Yuspa, S.H. *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 9, 3908-3912(Sep 1977).

12-O-Tetradecanoyl phorbol-13-acetate (TPA), a tumor promoter, stimulates DNA synthesis in mouse epidermal cells in vivo and in vitro. This response appears to be mediated through polyamine metabolism because ornithine decarboxylase activity is markedly increased shortly after promoter exposure and this induction varies in magnitude according to dose and promoter potency of a series of phorbol esters. In vitro, exogenous putrescine (0.01-10 mM) results in a dose-related increase and prolongation of promoter-stimulated DNA synthesis, a phenomenon noted in other systems of polyamine-mediated growth stimulation. The anti-inflammatory steroid fluocinolone acetonide (FA), an inhibitor of tumor promotion, prevents TPA stimulation of epidermal proliferation in vivo and in vitro. In vitro, FA most effectively prevents stimulation of DNA synthesis when applied prior to TPA, and its continued presence after TPA treatment is not required. Paradoxically, FA potentiates the increase in ornithine decarboxylase activity after TPA administration both in vivo and in vitro. Furthermore, the inhibition of TPA-stimulated DNA synthesis by FA in vitro can be reversed by exogenous putrescine. These results suggest that FA exerts its anti-promotion effect by reducing the sensitivity of the cell to polyamines or by reducing intracellular polyamine levels.

43632 Postsynthetic modification of human α-fetoprotein controls its immunosuppressive potency. Lester, E.P.; Miller, J.B.; Yachnin, S. (Univ. of Chicago). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 9, 3988-3992(Sep 1977).

In a previous study, we demonstrated three variants of human α-fetoprotein by crossed immunoelectrophoresis. In addition, we correlated the capacity of α-fetoprotein isolates from various hepatoma and fetal sources to suppress human lymphocyte transformation in vitro with the relative proportion of the electronegative variant, HAFP-3, present in each isolate. We have now isolated α-fetoprotein from the serum, ascitic fluid, and saline extract of tumor from a single hepatoma patient and from a homogenate of fetal livers. When tested for their capacity to inhibit human lymphocyte transformation in vitro, tumor and fetal liver α-fetoprotein were found to be extremely potent, serum α-fetoprotein had intermediate potency, and ascitic fluid α-fetoprotein was the least potent. Analysis of these isolates by crossed immunoelectrophoresis confirmed the correlation between the proportion of HAFP-3 and the immunosuppressive potency of each isolate. In addition, analysis of these isolates by isoelectric focusing in polyacrylamide gels containing 8 M urea revealed further evidence of microheterogeneity; at least six molecular variants were apparent. The proportion of one of these variants, termed HAFP-3a, in each isolate was correlated with the immunosuppressive potency of the isolate. The sialic acid content of the various α-fetoprotein isolates did not vary significantly. Our data suggest that a postsynthetic modification of α-fetoprotein occurs, probably after secretion, which reduces immunosuppressive potency by converting the active electronegative species to an inactive electropositive form. This modification probably involves a charged moiety other than sialic acid on the molecule.

43633 Immunologic similarities of thrombopoietin from different sources. McDonald, T.P.; Cottrell, M.; Nolan, C.; Walasek, O. (Univ. of Tennessee Memorial Research Center, Knoxville). *Scand. J. Haematol.;* **18**: 91-97(1977).

Thrombopoietin (TSF) has been detected in kidney cell culture media and human urine fractions by both a bioassay and an immunoassay using antisera raised against TSF-rich kidney cell culture medium and human urinary thrombopoietin. Both antisera cross-reacted with the 2 sources of TSF and gave essentially the same results in the HAI assay, a finding that suggests similarities in immunologic determinants of these 2 thrombopoietin preparations.

43634 Isolation and characterization of pteridines from heads of Drosophila melanogaster by a modified thin-layer chromatography procedure. Wilson, T.G.; Jacobson, K.B. (Oak Ridge National Lab., TN). *Biochem. Genet.;* **15**: No. 3/4, 307-319(1977).

An improved thin-layer chromatography technique is described for the separation of fluorescent compounds found in extracts of heads of Drosophila melanogaster. Eighteen to twenty fluorescent spots are resolved, two of which are xanthurenic acid and 3-hydroxykynurenine, and the remaining spots are presumably pteridines. Of these, nine have been identified and quantitated directly on the chromatograms with a fluorometer. One of the spots present on the chromatogram apparently has not been described previous to this work. Characteristics of this substance, termed "quench spot," are presented, several of which indicate that it may be a pteridine or pteridine derivative.

43635 Prenatal biotransformation of benzo[α]pyrene and N-2-fluorenylacetamide in human and subhuman primates. Juchau, M.R.; Berry, D.L.; Zachariah, P.K.; Namkung, M.J.; Slaga, T.J. (Univ. of Washington, Seattle). pp 23-34 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

In our laboratory we are focusing attention on the capacity of fetal tissues from humans and subhuman primates to catalyze various enzymatic reactions which may be highly important in transplacental chemical carcinogenesis, mutagenesis, teratogenesis, and other fetotoxic effects. High-pressure liquid chromatography has allowed us to examine in greater detail the profiles of metabolites formed in the various organs studied. As substrates, we have utilized benzo[a]pyrene (BP) and N-2-fluorenylacetamide (FAA). The use of BP presents at least two distinct advantages: the fluorometric assay of the 3-hydroxylated metabolite is extremely sensitive, and recently developed assay procedures utilizing high pressure liquid chromatography (HPLC) now enable much closer examination of the fate of this precarcinogen in various tissues. The polynuclear aromatic amine derivative FAA is an extremely useful substrate for studies of mechanisms of metabolic hydroxylation since it is hydroxylated simultaneously at several stereochemically and electronically different ring carbons and also on the nitrogen. Oxidative attack at the nitrogen atom has attracted particular attention since it represents a theoretic bioactivation mechanism important in tumor initiation. Oxidations at the carbons probably are detoxicating reactions. In studies of epoxide hydrase, glutathione S-epoxide transferase and dihydrodiol dehydrogenase we have utilized napthalene-1,2-oxide, a useful model substrate for the assessment of these enzymatic activities.

43636 Recent studies on benzo[α]pyrene metabolism in rat liver and lung. Vadi, H.; Jerstroem, B.; Orrenius, S. (Karolinska Inst., Stockholm). pp 45-61 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The metabolism of polycyclic hydrocarbons (PCH) was studied in lung and liver microsomes, isolated hepatocytes, and in combinations of organelle fractions, isolated from the liver. Results are summarized under the following headings: isolation of a rat lung microsomal fraction; characterization of the aryl hydrocarbon hydroxylase (AHH) system in rat lung microsomes; metabolism of phenolic products formed from benzopyrene; benzopyrene metabolism in rat hepatocytes; and formation and transfer of reactive PCH metabolites. (HLW)

43637 Hepatic and extrahepatic glutathione S-transferase activity toward several arene oxides and epoxides in the rat. Bend, J.R. (National Institutes of Health, Research Triangle Park, NC); Ben-Zvi, Z.; Van Anda, J.; Dansette, P.M.; Jerina, D.M. pp 63-75 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Rat hepatic 176,000 x g supernatant fraction had glutathione S-transferase activity toward each of the radiolabeled polycyclic arene oxides and epoxides tested, which included styrene oxide (S.O.), 1,2-epoxyoctane (O.O.), benzo[a]anthracene 5,6-oxide, 3-methylcholanthrene 11,12-oxide, phenanthrene 9,10-oxide, dibenzo[a,h]anthracene 5,6-oxide (D.B.A.O.), benzo[a]pyrene 4,5-oxide (B.P.O.), benzo[a]pyrene 7,8-oxide, benzo[a]-pyrene, 9,10-oxide and benzo[a]pyrene 11,12-oxide, although with the two non-K-region arene oxides (benzo[a]pyrene 7,8- and 9,10-oxides) this activity was very low. Arene oxide- or epoxide concentration-activity, glutathione (GSH) concentration-activity, pH-activity, and protein concentration-activity relationships were determined for S.O., O.O., and B.P.O. with rat liver soluble fraction. Supernatant fraction from lung, kidney, testis and small intestinal mucosa also had enzyme activity with each substrate studied (S.O., O.O., B.P.O., D.B.A.O., and benzo[a]pyrene 11,12-oxide) although extraheptic specific activities were, in general, lower than those of liver (5—100%). Although phenobarbital pretreatment induced hepatic glutathione S-transferase activity toward styrene oxide, the amount of induction varied from experiment to experiment (1.3- to 2.0-fold). 3-Methylcholanthrene pretreatment did not markedly affect hepatic specific glutathione S-transferase activities with any of the epoxide or arene oxide substrates tested.

43638 Synthesis and biologic activity of potential benzo[α]pyrene metabolites. Jerina, D.M. (National Institutes of Health, Bethesda, MD); Yagi, H.; Hernandez, O.; Dansette, P.M.; Wood, A.W.; Levin, W.; Chang, R.L.; Wislocki, P.G.; Conney, A.H. pp 91-113 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aroma-

tic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The relative mutagenic activities of BP 4,5-,7,8- and 9,10-oxides in several strains of Salmonella typhimurium and in Chinese hamster V79 cells were not correlated with the carcinogenic activities of the three arene oxides of BP. BP 4,5-oxide was highly mutagenic towards bacterial and mammalian cells, -whereas the BP 7,8- and 9,10-oxides were less than one percent as mutagenic. Enzymatic hydration, conjugation, or oxidation in mouse skin may selectively inactivate BP 4,5-oxide before it reaches its site of action, and thus detoxification reactions may explain its weak carcinogenic activity. Notably, the glutathione S-transferases are more active toward BP 4,5-oxide compared to BP 7,8- and 9,10-oxides. Two mechanisms are possible for the carcinogenic activity of BP 7,8-oxide. If BP 7,8-oxide is an ultimate carcinogen formed from BP, the reduced activity of this arene oxide on topical application compared to BP must be due to substantial destruction of the arene oxide prior to reaching its site of action within the cell. Alternatively, BP 7,8-oxide may be a proximate carcinogen which must be metabolically activated to an ultimate carcinogen. This could explain its weak mutagenic activity in Salmonella typhimurium and Chinese hamster V79 cells, since these cell lines have no mixed-function oxidase activity.

43639 Metabolism of benzo[α]pyrene by purified liver microsomal cytochrome P-448 and epoxide hydrase. Lu, A.Y.H.; Levin, W.; Vore, M.; Conney, A.H.; Thakker, D.R.; Holder, G.; Jerina, D.M. (Hoffmann-La Roche, Nutley, NJ). pp 115-126 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The metabolism of BP to arene oxides is catalyzed by the liver microsomal monooxygenase system consisting of cytochrome P-450 or P-448, NADPH-cytochrome c reductase and lipid. Various purified cytochromes P-450 and P-448 metabolize BP at very different rates; rat cytochrome P-448 is the most effective enzyme, whereas rabbit cytochrome P-448 is the least active catalyst we have studied. In the absence of epoxide hydrase, BP oxides rearrange to phenols with the exceptions of BP 4,5-oxide which is rather stable. Upon addition of epoxide hydrase to the monooxygenase system, significant amounts of dihydrodiols are produced at the expense of phenols and BP 4,5-oxide. These results demonstrate that metabolism of BP proceeds via at least three arene oxides. This coupled monooxygenase and epoxide hydrase system allows us not only to establish the enzymatic conversion of various polycyclic aromatic hydrocarbons to dihydrodiols via arene oxides, but the purified enzymes also provide a way of assessing the metabolic activation of chemicals to mutagens or carcinogens in vitro in the absence or presence of epoxide hydrase.

43640 Effects of benzoflavones and trichloropropene oxide on polynuclear aromatic hydrocarbon metabolism and initiation of skin tumors. Slaga, T.J. (Fred Huchinson Cancer Research Center, Seattle); Berry, D.L.; Juchau, M.R.; Thompson, S.; Buty, S.G.; Viaje, A. pp 127-137 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Mouse epidermis contains an NADPH-dependent AHH (BP-hydroxylase) which is inducible by PAH. The induction was as follows: 1,2,3,4-DBA > 1,2,5,6-DBA > BA > or = to 3-MC much greater than DMBA, which did not correlate with their ability to initiate tumors in mouse skin. However, a correlation appeared to exist between the tumor-initiating ability of several hydrocarbons and their ability to bind covalently to DNA in vitro using epidermal homogenates and NADPH as the electrophile-generating system (DMBA > 3-MC > BP > 1,2,5,6-DBA > 1,2,3,4-DBA). All the PAH studied had almost a complete requirement for NADPH for binding to DNA except DMBA. When added in vitro, 7,8-BF and 5,6-BF inhibited epidermal NADPH-dependent covalent binding of the above hydrocarbons by 50% or more. 7,8-BF was found to inhibit DMBA and MC initiation of skin tumors and stimulate the initiating ability of BP and 1,2,5,6-DBA. TCPO only slightly, or did not, increase the in vitro covalent binding of the above hydrocarbons to DNA. HPLC revealed that BP metabolism by epidermal homogenates resulted in essentially no dihydrodiols. However, TCPO was effective in increasing the skin tumor initiating ability of 3-MC, BP, and BP-4,5-epoxide, but not the initiating ability of 3-MC-11,12-epoxide, DMBA, and 1,2,5,6-DBA. The "K-region" epoxides of 3-MC and BP were very weak initiators when compared to the parent hydrocarbons.

43641 Relationship between levels of aryl hydrocarbon hydroxylase activity and susceptibility to 3-methylchloanthrene and benzo[α]pyrene-induced cancers in inbred strains of mice. Kouri, R.E. (Microbiological Associates, Bethesda, MD). pp 139-151 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

It is shown that susceptibility to MCA and benzo[a]pyrene-(BP)-induced fibrosarcomas (and carcinomas) is linked to naturally occurring differences in AHH levels, i.e., where AHH inducibility segregates as a codominant gene, or where noninducibility is dominant. Moreover, under conditions where AHH levels are artificially altered [e.g., treatment with the chemical defoliant, 2,3,7,8-tetrachlorodibenzo[a]dioxin (TCDD)], the inherent resistance of AHH nonresponsive mice to MCA-induced tumors can be overcome.

43642 Analysis of benzo[α]pyrene metabolism in human liver and lymphocytes and kinetic analysis of benzo[α]pyrene in rat liver microsomes. Selkirk, J.K. (Oak Ridge National Lab., TN); Yang, S.K.; Gelboin, H.V. pp 153-169 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Elucidation of the metabolite profile of polyaromatic hydrocarbons has significantly progressed with the advent of high-pressure liquid chromatography (HPLC). This technique has enabled isolation and separation of metabolite isomers not possible with other forms of chromatography and has also allowed unequivocable determination of at least one epoxide as a metabolic intermediate in the formation of dihydrodiols. We have also applied HPLC to study the kinetics of formation of BP metabolites in rat liver microsomes under conditions of several protein concentrations in the control versus methylcholanthrene-induced liver. In addition, we have studied the metabolism of BP in human liver and human lymphocytes in vitro and compared them to metabolites from the rodent liver microsomes. The studies reported here show that BP incubated with human tissue is converted to a large number of metabolites some of these identical to those formed by rat liver microsomes with an additional five to seven others which are distinct from those formed by rat liver and are of unknown structure. Thus we find unique species differences in BP metabolism between rat and human tissue.

43643 Biosynthesis and biological properties of 6-hydroxymethylbenzo[α]pyrene. Sloane, N.H. (Univ. of Tennessee, Memphis); Chen, H.; Diwan, B.; Bedigian, R.; Meier, H. pp 171-180 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

In our studies on the properties of aryl hydrocarbon hydroxymethyl synthetase we herein report that the enzyme is present in lung and liver as a microsomal membrane-bound form and as a soluble form, and that each form of the enzyme is activated by α-naphthoflavone (α-NF). In addition, we studied the biologic properties of derivatives of BP as carcinogenic agents in mice, and the ability of BP to transform mouse embryo cells cultured in the presence and absence of an inhibitor of cytochrome P-450, 1-benzylimidazole. Moreover, data are presented to demonstrate that W138 human lung diploid fibroblasts treated with BP and 1-benzylimidazole clone more effectively than with either treatment alone.

43644 Metabolic activation of aromatic hydrocarbons by one-electron oxidation in relation to the mechanism of tumor initiation. Cavalieri, E.; Roth, R.; Rogan, E.G. (Univ. of Nebraska, Omaha). pp 181-190 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

In this chapter the following major points are presented: the existence of inducible cytochrome P-450-linked nuclear enzymes, which catalyze the covalent binding of carcinogenic hydrocarbons to DNA under conditions in which oxygenation of the hydrocarbon cannot occur; mechanistic details pertaining to nucleophilic trapping of PAH radical cations formed under mild oxidizing conditions; and an in vivo isotope effect, as detected by a difference in carcinogenicity between 3-methylcholanthrene (MC) and 3-methylcholanthrene-1,1-5-d_3 (MC-d_3), which is paralleled in the in vitro reaction of MC radical cation with pyridine.

43645 Polycyclic hydrocarbon oxides, their formation, inactivation, and biologic effect. Bresnick, E.; Stoming, T.A.; Mukhtar, H.; Vaught, J.B. (Medical Coll. of Georgia, Augusta). pp 191-201 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

We have described in this chapter: the activities and some of the properties of the two enzymes which are functional in the detoxification of 3-MC-11,12-oxide, epoxide hydrase and GSH S-epoxide transferase; reported data on the binding of labeled polycyclic hydrocarbon to DNA, to chromatin and to nuclei in microsomal NADPH-supplemental systems; and presented some experiments that bear upon the aspect of DNA repair in human cells.

43646 Carcinogenic activity of benz[α]anthracenes. Newman, M.S. (Ohio State Univ., Columbus). pp 203-207 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Nine (11) of the eleven monofluoro-7-methylhenz[a]anthracenes were synthesized (12—17) and tested. Of these, only 5-fluoro-7-methylbenz[a]anthracene was inactive as a carcinogen. Hence, it was concluded that the 5-position is the one involved in the carcinogenic process. To summarize our hypotheses, the 7-position in benz[a]anthracene is the position at which a detoxification occurs. To obtain carcinogenic activity the 7-position must be blocked. The 5-position is the position at which metabolism occurs to produce cancer. Blockage of the 5-position destroys carcinogenic activity. The above hypothesis relate mainly to monomethylbenz[a]-anthracenes.

43647 Benzo[a]pyrene metabolite identification: an example of NMR as an analytic technique. Clarke, P.A. (Battelle Columbus Labs., OH). pp 311-318 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The work reported here is part of a Battelle Institute-supported study of benzo[a]pyrene (BaP) metabolism at cell wall membranes using carbon-13 NMR. During this research, problems arose in metabolite identification and purity determination. Because the literature on NMR spectral identification of BaP metabolites is very sparse, a proton FT-NMR study of BaP metabolite identification and differentiation was undertaken to provide a data bank of spectral information. Fourier transform nuclear magnetic resonance spectroscopy is s powerful analytic tool for structure determination. Even though chemical shift assignments cannot always be made, sufficient data can be obtained to enable compound differentiation. This technique is applicable to complex polynuclear aromatic hydrocarbons, and should easily be applicable to other toxic or carcinogenic compounds.

43648 On the structure and carcinogenicity of the methylchrysenes. Hecht, S.S.; Loy, M.; Hoffmann, D. (American Health Foundation, Valhalla, NY). pp 325-340 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The carcinogenic activity of the six methylchrysene isomers was assayed on mouse skin. 5-Methylchrysene (5-MeC) showed exceptional activity both as a tumor initiator and complete carcinogen; the other isomers showed only marginal activity. 5-MeC also showed carcinogenic activity when assayed by subcutaneous injection in mice. Compared to benzo(a)pyrene (BaP), 5-MeC was a stronger tumor initiator and had comparable activity as a complete carcinogen. Modified chrysenes were synthesized in order to assay the importance of the electronic distribution at various ring positions of 5-MeC and the degree to which the non-planar configuration of 5-MeC effects its carcinogenic activity. Compared to 5-MeC, 12-fluoro-5-methylchrysene was a weaker tumor initiator on mouse skin, while 5-methoxychrysene was somewhat less active. 1-Fluoro-4-methylchrysene and 6-methoxy-5-methylchrysene lacked significant tumor initiating activity. Based on these results, we can tentatively draw the following conclusions: the 12 position is involved in metabolic activation of 5-MeC, but not uniquely, deformation from planarity s not a sufficient condition for carcinogenicity in the methylchrysene system, and metabolic activation of 5-MeC takes place at a ring carbon.

43649 Polycyclic aromatic hydrocarbon derivatives: synthesis and physicochemical characterization. McCaustland, D.J. (Midwest Research Inst., Kansas City, MO); Fischer, D.L.; Kolwyck, K.C.; Duncan, W.P.; Wiley, J.C. Jr.; Menon, C.S.; Engel, J.F.; Selkirk, J.K.; Roller, P.P. pp 349-411 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Carcinogenesis studies of polycyclic aromatic hydrocarbons (PAH) necessitate the availability of a variety of suspect or established metabolites, i.e., oxygenated derivatives such as arene oxides, phenols, dihydrodiols, quinones, etc. The five PAH being examined are benzo[a]pyrene (BP), benz[a]anthracene (BA), dibenz[a,h]anthracene (DBA), 3-methylcholanthrene (MCA), and 7,12-dimethylbenz[a]anthracene (DMBA). Derivatives were prepared by known or modified literature methods or by novel routes. Physicochemical characterization data provided herein to establish compound identity and purity should prove useful for PAH metabolism studies, or syntheses or both.

CYTOLOGY

REFER ALSO TO CITATION(S) 43673, 43676, 43680

43650 (LA—7247-PR) Detection of early changes in lung cell cytology by flow-systems analysis techniques. Progress report, July 1—December 31, 1977. Steinkamp, J.A.; Hansen, K.M.; Wilson, J.S.; Saunders, G.C.; Orlicky, D.J.; Crissman, H.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

This report summarizes ongoing experiments to develop cytological and biochemical indicators for measuring damage to respiratory tract cells exposed by inhalation of environmental toxic agents. The specific goal of this project is to apply flow cytometric methods to analyze and detect changes in lung epithelium as a function of exposure to toxic agents such as those associated with the production of synthetic fuels from oil shale and coal. The objectives during the past 6 months were to complete modifications to the multiparameter cell separator by adding a krypton laser with an output capability of specific wavelengths ranging from the uv to the ir; analyze and separate lung cells based on their DNA content; evaluate some new fluorescent DNA and protein stains; and treat hamster lung cells with proteolytic enzymes for increasing cell yield. Future experiments will involve the continued analysis and characterization of exfoliated lung cells based primarily on cellular DNA content, protein, morphological features, and specific enzyme activities; quantitation of macrophage activity; exposure of hamsters to toxic agents such as oil shale particulates and ozone; and continued analysis of cells based on DNA content. As this new technology becomes adapted to analyzing respiratory tract cells, the measurement of physical and biochemical cell properties as a function of exposure to toxic agents will be increased. This analytical approach is designed to assist in the establishment of guidelines for estimating risks to exposed humans.

43651 Cytogenetics of fibroblastic colonies in Ph^1-positive chronic myelogenous leukemia. Greenberg, B.R.; Wilson, F.D.; Woo, L.; Jenks, H.M. (Univ. of California, Davis). *Blood;* **51**: No. 6, 1039-1044(Jun 1978).

The cytogenetic status of bone marrow stromal elements obtained from six patients with Ph^1-positive chronic myelogenous leukemia (CML), two in blast crisis, was studied in vitro utilizing the potential of marrow to form surface-adherent colonies morphologically compatible with mesenchymal elements. We demonstrated the absence of both the market chromosome and other chromosomal abnormalities in all the fibroblastic colonies studied, indicating that the progenitors of such colonies (plaque-forming units in culture, PFU-C) are not closely related to hematopoietic elements including macrophages. This supports previous reports suggesting that the stromal elements in myelofibrosis associated with CML are not derived from the primary Ph^1-positive malignant clone but represent a stromal reactive component of benign or independent malignant potential.

43652 Variants of 3T3 cells lacking mitogenic response to epidermal growth factor. Pruss, R.M.; Herschman, H.R. (Univ. of California, Los Angeles). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 9, 3918-3921(Sep 1977).

We have previously demonstrated that epidermal growth factor (EGF) can serve as a potent mitogen for 3T3 cells. We have now selected variant 3T3 cell lines unable to respond to EGF, in order to define cellular events unique to the EGF response and to distinguish which of these events are necessary and which are merely correlative to mitogenesis. By simultaneously treating cells with EGF and colchicine, we eliminated those cells stimulated by EGF to enter mitosis. Of the eight clonal EGF nonresponder variants selected by this procedure, none retains a functional EGF receptor. The EGF nonresponsive variant lines still retain the ability to respond to other mitogens.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43717

GENETICS

REFER ALSO TO CITATION(S) 42258

43653 Genetic lengths and break points in twelve chromosomes of Gossypium hirsutum involved in ten reciprocal translocations. Menzel, M.Y. (Florida State Univ., Tallahassee); Brown, M.S. *Genetics;* **88**: No. 3, 541-558(Mar 1978).

Chromosome configurations were recorded in about 5500 pollen mother cells (PMC's) in 2n and 2n-1 (missing the intact A-

genome chromosome) heterozygotes of ten reciprocal translocations involving six A-genome chromosomes (H1, H2, H3, H4, H6 and H7) and six D-genome chromosomes (H14, H15, H16, H19, H20 and H21) of Gossypium hirsutum. From these records, chiasma frequencies at each of six positions were determined for nine translocations and at two positions for one. These frequencies were used to calculate recombination frequencies in different chromosome regions, and from these distances the breakpoints in 15 chromosome arms were mapped relative to each other and to their respective centromeres, insofar as the data permitted. The karyotype so derived for twelve chromosomes is in reasonably good agreement with data from genetic mapping, telosome and monosome mapping, and the mitotic idiogram.

43654 Comparison of the genetic infrastructure of the Ye'cuana and the Yanomama: a likelihood analysis of genotypic variation among populations. Smouse, P.E. (Univ. of Michigan, Ann Arbor); Ward, R.H. *Genetics;* **88**: No. 3, 611-631(Mar 1978).

A general procedure is described for measuring and testing population differences in gametic frequencies. The total dispersion among populations is subdivided in hierarchical fashion. The multiple-locus treatment is simply the sum of the single-locus analyses, provided gametic equilibrium obtains among the loci. In the event that gametic equilibrium does not obtain, correlations among loci need to be dealt with. The analysis is then used to examine the genetic infrastructure of two Indian tribes from South America, the Ye'cuana (Makiritare) and the Yanomama. From historical evidence, we may identify several clusters of villages within each tribe. The demographic and cultural practices affecting village formation and the maintenance of peer integrity are rather different in these tribes, however, and lead us to postulate rather different patterns of genetic variation among villages. Analyses of five codominant two-allele loci, four dominant two-allele loci and two complex loci (with four codominant haplotypes each) demonstrate that Yanomama clusters are more disparate than Ye'cuana clusters, as would have been predicted on socio-cultural grounds.

43655 Heterosis as an explanation for large amounts of genic polymorphism. Lewontin, R.C. (Harvard Univ., Cambridge, MA); Ginzburg, L.R.; Tuljapurkar, S.D. *Genetics;* **88**: No. 1, 149-170(Jan 1978).

By using both numerical and analytical approaches, we have shown that heterosis alone is not a mechanism for maintaining many alleles segregating at a locus. Even when all heterozygotes are more fit than all homozygotes, the proportion of fitness arrays that will lead to a stable, feasible equilibrium of more than 6 or 7 alleles is vanishingly small. More alleles can be maintained if, in addition to heterosis, it is assumed that there is very little variation in fitness from heterozygote to heterozygote, with the ratio of mean heterosis to standard deviation of fitness among heterozygotes in the neighborhood of 10. When such conditions hold, the allelic frequency distribution and equilibrium will be very uniform, with all alleles very close to equal frequency $p = (1/n)$. It is much more likely that stable equilibria for multiple alleles will be best explained by multiple niche selection.

43656 Mechanism of suppression in Drosophila. V. Localization of the purple mutant of Drosophila melanogaster in the pteridine biosynthetic pathway. Wilson, T.G.; Jacobson, K.B. (Oak Ridge National Lab., TN). *Biochem. Genet.;* **15**: No. 3/4, 321-332(1977).

The suppressible eye color mutant purple (pr) of Drosophila melanogaster is known to be unable to synthesize a wild-type complement of pteridine eye pigments. This study measures the reduced levels of drosopterins, sepiapterin, and an unidentified presumed pteridine in pr and pr/sup bw/. Pteridine analyses in double mutants combining pr with one of three other eye color mutants sepia, Henna-recessive^3, and prune^2, suggest that the metabolic block in pr occurs prior to sepiapterin biosynthesis. Measurements of GTP and GTP cyclohydrolase in pr showed wild-type levels and indicate the metabolic block in pr to be at one of the steps converting dihydroneopterin triphosphate to sepiapterin. Quantitation of pteridines in suppressed purple [su(s)^2; pr and pr; su(pr)/sup e3/] shows restoration of pteridines to wild-type or nearly wild-type levels.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43634

43657 Mitochondrial transfer RNAs in yeast: identification of isoaccepting transfer RNAs. Martin, N.C.; Rabinowitz, M. (Univ. of Chicago). *Biochemistry;* **17**: No. 9, 1628-1634(2 May 1978).

To delineate the total number of tRNAs encoded by yeast mitochondrial DNA (mtDNA), we have examined mitochondrial tRNA preparations for the presence of heterogenic isoaccepting tRNAs. Analyses of ^{3}H-labeled aminoacylated mitochondrial tRNAs by reversed-phase column chromatography (RPC-5) coupled with hybridization to mtDNA detected only one major mitochondrially coded tRNA for alanine, arginine, aspartic acid, glycine, histidine, isoleucine, leucine, lysine, proline, serine, and tryptophan. Some of these profiles also contained one or more minor peaks that may represent small amounts of heterogenic isoacceptors, but their low concentrations prevented their characterization. Cysteinyl-, methionyl-, phenylalanyl-, threonyl-, tyrosyl-, and valyl-tRNAs separated into multiple species upon RPC-5 chromatography. Two cysteinyl-, two methionyl-, two phenylalanyl-, two threonyl-, four tyrosyl-, and two valyl-tRNA species hybridized to mtDNA. The hybridization of the phenylalanyl- and the valyl-tRNA species was not additive, indicating that their sequences are similar, if not identical, and suggesting that they may be transcribed from the same genes. The two methionyl-, and two threonyl-, and probably the two cysteinyl-tRNAs are transcribed from separate genes, since their hybridizations to mtDNA are additive. That the methionyl-tRNAs are transcribed from separate genes was further confirmed through deletion mapping experiments which showed that the genes coding for these tRNAs are at different locations on the mtDNA. The transcriptional relationship of the four tyrosyl-tRNAs was not established. There is at least a cistron coding for tRNAs corresponding to each of the common amion acids except asparagine and several amino acids (methionine, threonine, and cysteine) are accepted by more than one transcriptionally distinct tRNA. Thus, a minimum of 22 tRNA cistrons have been identified.

METABOLISM

REFER ALSO TO CITATION(S) 42257, 43615, 43636, 43637, 43638, 43639, 43640, 43641, 43642, 43644, 43722, 43723

43658 Kynureninase-type enzymes and the evolution of the aerobic tryptophan-to-nicotinamide adenine dinucleotide pathway. Gaertner, F.H.; Shetty, A.S. (Oak Ridge National Lab., TN). *Biochim. Biophys. Acta;* **482**: 453-460(1977).

Kynureninase-type (L-kynurenine hydrolase, EC 3.7.1.3) activity has been found to be present in the livers of fish, amphibia, reptiles, and birds. In addition to past information concerning this enzyme activity in mammalian liver, it is now clear that all the major classes of vertebrates carry a highly specialized kynureninase-type enzyme, which we have termed a hydroxykynureninase. To compare the reactivities of these enzymes with L-kynurenine and L-3-hydroxykynurenine, ratios of tau values (K/sub m//V) were used. Based on this comparison, the bacterium Pseudomonas fluorescens carries the most efficient kynureninase, whereas the amphibian Xenopus laevis has the most efficient hydroxykynurenase. In these two cases, the ratio of tau values differs by a factor of 38,000. It is hypothesized that the tryptophan-to-nicotinamide adenine dinucleotide biosynthetic pathway evolved from a catabolic system of enzymes, and that the differences observed in the kynureninase-type enzymes between lower and higher organisms reflect the specialization of the function of these enzymes from a strictly catabolic role to an anabolic one during the course of evolution.

43659 Metabolism of benzo[α]pyrene in human adult and fetal tissues. Pelkonen, O. (Univ. of Oulu, Finland). pp 9-21 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Enzymes biotransforming BaP are present in several human adult and fetal tissues. The incubation in vitro of BaP with human adult and fetal liver preparations, and with fetal adrenal gland and placental preparations, yielded the usual pattern of BaP metabolites, including water-soluble products, several diols (implicating corresponding epoxides), hydroxymetabolites and quinones, as well as products bound covalently to tissue constituents. The same metabolite fractions were detected when BaP was incubated with cultured fetal liver cells and fibroblasts. In the BaP metabolite pattern there was certain differences between in vitro (tissue preparations) and in vivo (cells in culture) experiments. The main metabolites in in vitro experiments were phenols, whereas in vivo experiments BaP-diols and more water-soluble metabolites constituted the largest metabolite fraction. Studies presented here present no crucial differences in the metabolic fate of BaP between man and laboratory animals.

43660 Enzyme induction and the difference in the metabolite patterns of benzo[α]pyrene produced by various strains of mice. Wang, I.Y.; Rasmussen, R.E.; Petrakis, N.L.; Wang, A.C. (Medical Univ. of South Carolina, Charleston). pp 77-89 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Mice of five different strains were injected intraperitoneally with a solution of benzopyrene in corn oil, control mice received corn oil only. Tritium-labeled benzopyrene was incubated with microsomes from liver, lungs, spleen, and kidneys. A table is present-

ed to show the quantitative comparison of metabolites of benzopyrene catalyzed by livers of the different strains of mice. Other tables are presented to show metabolism of benzopyrene by microsomes of lungs, spleen, and kidneys. Comparisons of results in different strains of mice are given. (HLW)

43661 Corticosteroids and lymphoid tissue. Munck, A.; Young, D.A. (Dartmouth Medical School, Hanover, NH). pp 231-243 of Handbook of Physiology: Endocrinology VI. Baltimore; Williams and Wilkins, Co. (1975).

Relationships between the adrenal cortex hormones and the lymphoid system are reviewed under the following headings: lymphoid system and immune responses; actions of hormones on lymphoid tissues and glucocorticoid specificity; effects of glucocorticoids on lymphocyte morphology and lymphoid tissue organization and function; metabolic effects of glucocorticoids on lymphoid tissue; glucocorticoid receptors and initial steps in actions of glucocorticoids on lymphoid cells; and physiological significance of glucocorticoid actions on lymphoid tissue. (HLW)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43719

MEDICINE

REFER ALSO TO CITATION(S) 43731

43662 (CONF-780234—1) **Chronopharmacology of L-DOPA: implications for orthochronal therapy in the prevention of circadian dyschronism.** Ehret, C.F.; Meinert, J.C.; Groh, K.R. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

From Symposium on clinical chronopharmacy, chronotherapeutics, chronopharmacology; Tallahassee, FL, USA (10 Feb 1978).

Two experimental results showed a significant influence of the circadian phase time-of-administration of L-DOPA upon the circadian rhythm of the rat, as judged by measures of core temperature. It is concluded that, in order to minimize the deleterious side effects and maximize the beneficial effects of a drug such as L-DOPA, orthochronal therapy is indicated. How orthochronal is to be defined when extrapolated to organisms apparently deficient in either tyrosine hydroxylase or in L-DOPA itself (as in the case of Parkinson's disease) will require experimental trial with appropriate subjects.

43663 (HRP—0015210) **Emergency medical services: an overview.** Jelenko, C.; Frey, C.F. (Medical Coll. of Georgia, Augusta (USA). Dept. of Surgery). 1976. 343p. Available from Robert J. Brady Co., Routes 197 and 450, Bowie, MD 20715.

The organization and delivery of emergency care are reviewed in a book based on the judgments of 28 national leaders in various fields. It is noted that acute illness has become a major health problem due to the rapid growth of the United States and the increased demands of consumers for improved medical care. Critical needs in the field of emergency care are identified as communications, prompt and proper rescue handling, rapid and careful transportation of victims, and adequate emergency care at hospitals. The long-term solution to the problem of injury is viewed as prevention through efforts made by educators, industrialists, engineers, public health officials, and private citizens. The statement is made that accidents are exceeded only by heart disease, neoplasms, and cerebral vascular disease as a major cause of death in the United States. The dimensions of the accident problem are explored. Other topics addressed are: motor vehicle trauma and emergency medical services; the provision of emergency care to cardiac patients; medicolegal implications of emergency care; and field treatment and transport of emergency victims. The importance of telecommunications, emergency medical technician training, and public education is stressed. Hospital education and training for emergency department personnel are detailed for physicians and nurses. Functional and design aspects of hospital emergency departments are described, and the role of community planning in the provision of emergency health services is considered. A checklist for airport disaster planning and a Michigan law regarding emergency medical services are appended.

43664 (PB—273244) **Environmental influences on the immune system and allergic reactions. Final report 1970—1976.** Adkinson, N.F. Jr. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 24p. NTIS PC A02/MF A01.

Environmental interactions with the immune system may result in two types of adverse outcomes: immunodeficiency and immunopathology. Serious immunodeficiency most commonly results from ionizing radiation or as a recognized side effect of iatrogenic drug therapy, usually cancer chemotherapy. At present, there is no basis for believing that biologically significant suppression of immune competence results from more subtle interactions with environmental agents. On the other hand, environmentally triggered immunopathology is a source of considerable morbidity and mortality. Additional research is needed on the basic mechanisms of immunopathological reactions, on the development of methods for accurately implicating or excluding immunological mechanisms in the etiology of hypersensitivity states, on the development of methods for assessing in advance the potential immunogenicity and allergenicity of new industrial chemicals and occupational allergens, and on the identification of the risk factors which predispose to immunopathological outcomes when individuals are exposed to sensitizing chemicals or other natural allergens.

43665 (PB—273246) **Carcinogenesis. Final report 1970—1976.** Clayson, D.B. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 48p. NTIS PC A03/MF A01.

Cancer induction by chemicals and radiation has been demonstrated in both humans and animals. Viruses have proven to be potent animal carcinogens, but the evidence for their effectiveness in many has not yet been demonstrated unequivocally. The frequency and time of onset of both induced and naturally occurring tumors may be modified both by environmental factors and characteristics of the host. It is the interaction of such factors which makes the design of mathematical models for the quantification of the carcinogenic process an inexact, hazardous, and often fruitless experience. The paper concludes with a listing of recommendations for research in this subject area. (Portions of this document are not fully legible)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43699

43666 (BNL—24092) **Medical application of in vivo neutron activation analysis.** Cohn, S.H.; Ellis, K.J.; Vartsky, D.; Zanzi, I.; Aloia, J.F. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 20p. (CONF-780538—1; IAEA-SM—227/63). Dep. NTIS, PC A02/MF A01.

From Symposium on nuclear activation techniques in the life sciences; Vienna, Austria (22 May 1978).

The clinical usefulness of total body neutron activation analysis (TBNAA) was clearly established at an IAEA panel meeting in Vienna in 1972. It is best demonstrated by the studies involving the measurement of total-body calcium. This measurement provides data useful for the diagnosis and management of metabolic bone disorders. It should be emphasized, however, that while most of the applications to date have involved calcium and phosphorus, the measurement of sodium, chlorine and nitrogen also appear to be useful clinically. Total-body calcium measurements utilizing TBNAA have been used in studies of osteoporosis to establish absolute and relative deficits of calcium in patients with this disease in comparison to a normal contrast population. Changes in total-body calcium (skeletal mass) have also been useful for quantitating the efficacy of various therapies in osteoporosis. Serial measurements over periods of years provide long-term balance data by direct measurement with a higher precision (+- 2%) than is possible by the use of any other technique. In the renal osteodystrophy observed in patients with renal failure, disorders of both calcium and phosphorus, as well as electrolyte disturbances, have been studied. The measure of total-body levels of these elements gives the clinician useful data upon which to design dialysis therapy. The measurement of bone changes in endocrine dysfunction has been studied, particularly in patients with thyroid and parathyroid disorders. In parathyroidectomy, the measurement of total-body calcium, post-operatively, can indicate the degree of bone resorption. Skeletal metabolism and body composition in acromegaly and Cushing's disease have also been investigated by TBNAA. Levels of cadmium in liver and kidney have also been measured in-vivo by prompt-gamma neutron activation and associated with hypertension, emphysema and cigarette smoking.

43667 (COO—2361-1) **Labeling pharmaceuticals with radioactive isotopes. Final report, June 1, 1973—November 30, 1977.** Blau, M.; Bender, M. (Health Research, Inc., Buffalo, N.Y. (USA)). Apr 1978. Contract EY-76-S-02-2361. 13p. Dep. NTIS, PC A02/MF A01.

Isosteric replacement of a methyl group by a halogen atom (bromine or iodine) in natural compounds often does not impair chemical or biological properties. Iodo and bromo aliphatic amino acid analogs have been synthesized and studied for possible use as pancreas localizing agents. Rather than using the short-lived gamma-emitting isotopes of bromine suitable for scanning, the ^{14}C labeled compounds were prepared. The valine analog, β-bromo-α-aminobutyric acid, was synthesized from ^{14}C L-threonine and its distribution was studied in rats. Contrary to expectations, this compound showed no pancreas uptake or any other amino acid behavior. The failure of this bromo for methyl substituted compound to be biologically

active is rather surprising in view of the good match in physical properties and previous success in analog localization. Iodo analogs of leucine (γ-iodo-α-aminopentanoic acid) and valine (β-iodo-α-aminobutyric acid) have been prepared with ^{125}I labels. These compounds proved to be quite unstable and were rapidly deiodinated. It is clear that these bromo and iodo analogs of aliphatic amino acids are not useful as pancreas localizing agents.

43668 Radiographic and radionuclide findings in Rhizopus osteomyelitis. Moore, P.H. Jr.; McKinney, R.G.; Mettler, F.A. Jr. (Univ. of New Mexico, Albuquerque). *Radiology;* **127**: No. 3, 665-666(Jun 1978).

A case of Rhizopus osteromyelitis is described. The radionuclide and radiographic findings differ from those of osteomyelitis secondary to common pathogens: low-level radionuclide activity is observed, while soft-tissue swelling, periosteal reaction, and loss of fascial margins are absent.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 43619, 43621, 43627, 43628

43669 (PB—273820) **Fermentation and enzymatic saccharification of cellulose and lignin waste. Completion report 1 Jul 75—30 Sep 77.** Barnett, S.M.; Rand, A.G. Jr.; Houston, C.W.; Aidala, D. (Rhode Island Univ., Kingston (USA)). Sep 1977. Contract DI-14-34-0001-6115. 122p. NTIS PC A06/MF A01.

An ever existent problem of primary concern is that of providing water for safe use. Although much scientific research has been devoted to alleviating this problem, it has only been within recent years that lignin and cellulose, a traditional waste material, has been recognized as a potential raw material. The development of the technology to utilize waste cellulose and lignin as a fermentation or hydrolysis substrate would afford several opportunities: it could help mitigate the waste water problem, provide a valuable raw material supply, aid in providing potential food products for an ever increasing world population, and allow for water reuse. The report describes a method for the degradation of cellulose utilizing a fungus enzyme system.

43670 Automatic assay of cellulase activity during fermentation. Leisola, M.; Kauppinen, V. (Helsinki Univ. of Tech., Espoo, Finland). *Biotechnol. Bioeng.;* **20**: No. 6, 837-846(Jun 1978).

An automatic method using dyed cellulose as a substrate was developed to determine the solubilizing activity of a cellulase complex. The automatic analyzer was connected to a fermentor and enzyme activity was successfully assayed during fermentation. A useful sampling arrangement was developed and the analysis was sensitive enough to make a short reaction time possible. Cellulase production with Trichoderma viride was used as a model process.

43671 Enzyme deactivation during cellulose hydrolysis. Howell, J.A. (University Coll. of Swansea, Eng.); Mangat, M. *Biotechnol. Bioeng.;* **20**: No. 6, 847-863(Jun 1978).

Hydrolysis of cellulose by Trichoderma viride cellulase reached a plateau after some 25 hr. If the initial enzyme-to-substrate ratio was low, resuspension of substrate in fresh enzyme or addition of enzyme resulted in further high rate hydrolysis. This did not occur if the initial ratio was high. Over 75% hydrolysis might be achieved in the former case, while less than 60% in the latter. A model postulating inactivation of adsorbed enzyme-substrate complex which blocked further hydrolysis was proposed, and it was found to fit the data well. The proposed model had five parameters, four of which could be checked by graphical methods, and all of which had physical meanings. The parameters were estimated by a nonlinear least-squares minimization FORTRAN computer program, using numerical integration and optimization of the parameters. The model was used to predict the resuspension data, powdered enzyme addition data, cellobiose addition data, and cellulose addition data; the deviations from the model are discussed. It was found that average values could be used for four out of the five parameters, while the fifth (initial enzyme concentration) did not correlate with independent measurements such as the filter paper activity or protein concentration.

43672 Antibiotic disks: an improvement in the filter paper assay for cellulase. Montenecourt, B.S. (Rutgers, The State Univ. of New Jersey, New Brunswick); Eveleigh, D.E.; Elmund, G.K.; Parcells, J. *Biotechnol. Bioeng.;* **20**: No. 2, 297-300(Feb 1978).

The filter paper assay method for cellulases is modified and improved by the use of antibiotic assay disks in place of the filter paper strips. A simple conversion factor will convert the assay disk results to comparable filter paper assay units. The advantages of the use of the antibiotic disk include no need for cutting or curling, reduction in fiber production, elimination of dilutions, and lower background in reducing sugars. (JSR)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43657

PATHOLOGY

REFER ALSO TO CITATION(S) 43651, 43674, 43731

43673 Marked reduction of spectrin in hereditary spherocytosis in the common house mouse. Greenquist, A.C.; Shohet, S.B.; Bernstein, S.E. (Univ. of California, San Francisco). *Blood;* **51**: No. 6, 1149-1155(Jun 1978).

In contrast to the disease in humans, hereditary spherocytosis in the common house mouse produces an extreme spherocytosis. The cells show a broad distribution in size ranging from microcytic to macrocytic. Of particular interest is the finding of a substantial reduction in the major membrane polypeptide called spectrin, supporting a critical role for this protein in the control of erythrocyte shape and membrane stability.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 43620, 43661

43674 Actively induced platelet-bound IgG associated with thrombocytopenia in the marmoset. Gengozian, N.; McLaughlin, C.L. (Oak Ridge Associated Universities, TN). *Blood;* **51**: No. 6, 1197-1210(Jun 1978).

Interspecies platelet immunizations among marmosets lead to antibody formation to the donor platelets and a profound thrombocytopenia, which when associated with anemia may result in death of the animal. This actively induced immonologic thrombocytopenia closely resembles two clinical disease entities manifesting autoimmune thrombocytopenia, posttransfusion purpura and idiopathic thrombocytopenic purpura. Although antibody to donor-type platelets could be demonstrated readily, antihost activity was most often nondetectable or, when present, was in very low titer. A consistent finding was the appearance of IgG on the host's platelets shortly after immunization and concomitant with the appearance of anti-donor platelet antibody. In 3 of 13 immunized animals thromoocytopenia did not occur even though antibody was formed and the host's platelets became IgG positive. In those animals that recovered from the induced thrombocytopenia IgG-positive platelets were found for periods ranging from 30 to greater than 100 days. Splenectomy before or after immunization did not alter the sequential development of antibody formation, appearance of IgG-positive platelets, and thrombocytopenia. Eluates prepared from IgG-positive platelets contained IgG and platelet antigens; the eluted IgG could attach nonspecifically to platelets of host or donor (immunizing) type, in contrast to the species specificity demonstrated for IgG eluted from platelets that had been reacted in vitro with specific antibody. Platelets in a few normal, nonimmunized marmosets were found to have signficant amounts of IgG on their surface, comparable to that observed in the immunized animal; interestingly, such IgG-positive platelets were found among imported but not laboratory-bred marmosets.

43675 Genetic control of immune responses to Moloney leukemia virus in rats. Jones, J.M. (National Center for Toxicological Research, Jefferson, AK); Jensen, F.; Feldman, J.D. *J. Natl. Cancer Inst.;* **60**: No. 6, 1467-1472(Jun 1978).

When BN and LEW rats were immunized with untreated or with inactivated Moloney murine leukemia virus (M-MuLV), BN rats produced high antibody responses to the p15, p30, and gp70 antigens of the virus, whereas LEW rats were low responders to these antigens. BN rats also exhibited a high response and LEW rats a low response when the two strains were immunized with purified p30. Studies of (LEW x BN)F_1 and backcross rats suggested that factors associated with AgB exerted major influences on responses to antigens of M-MuLV and that other factors were also important. When other rat strains representing 5 AgB alleles were tested, some were high and some were low responders to M-MuLV, and responses to p15, p30, and gp70 were not always parallel. Since M-MuLV replication was greater in cells of BN rats than in cells of LEW rats, replication of M-MuLV may have influenced the levels of responses to some viral antigens. Control of virus replication appeared to be due to cell mechanisms rather than to the environment of the host.

43676 Efflux of Ca^{2+} and Mn^{2+} from rat liver mitochondria. Gunter, T.E.; Gunter, K.K.; Puskin, J.S.; Russell, P.R. (Univ. of Rochester, NY). *Biochemistry;* **17**: No. 2, 339-345(24 Jan 1978).

Net efflux of Ca^{2+} and Mn^{2+} from previously loaded rat liver mitochondria has been studied. Several agents have been found

which affect Ca^{2+} efflux and Mn^{2+} efflux differently. Rapid efflux of either Ca^{2+} or Mn^{2+} follows addition of sufficiently large amounts of an uncoupler such as carbonyl cyanide m-chlorophenylhydrazone (CCCP) to loaded mitochondria. Under these conditions, ruthenium red greatly retards Mn^{2+} but not Ca^{2+} efflux. Under similar conditions a chelating agent such as ethylene glycol bis(β,$^-$ traacetic acid (EGTA) greatly retards Mn^{2+} but not Ca^{2+} efflux. Where very small amounts of CCCP are added to loaded mitochondria, on the other hand, Ca^{2+} efflux in the presence of EGTA can be significantly retarded. Furthermore, when rapid spontaneous Ca^{2+} efflux occurs, it is sometimes slowed or almost completely prevented by addition of small amounts of CCCP. The amount of CCCP which maximally inhibits Mn^{2+} efflux is approximately a factor of 20 higher than the amount which maximally inhibits Ca^{2+} efflux. Mn^{2+} efflux in the presence of EGTA or ruthenium red is greatly inhibited by metabolic inhibitors such as KCN while Ca^{2+} efflux is not. It is concluded that influx and efflux of Ca^{2+} and Mn^{2+} take place primarily through distinguishable mechanisms, and that the mechanisms facilitating the efflux of Ca^{2+} and Mn^{2+} are also distinct. Evidence is also presented supporting the hypothesis that Mn^{2+} efflux and perhaps Ca^{2+} efflux as well take place at least in part by means of an active mechanism.

TRACER TECHNIQUES

43677 Fate of thymocytes: studies with ^{125}I-iododeoxyuridine and ^{3}H-thymidine in mice. Joel, D.D. (Brookhaven National Lab., NY); Chanana, A.D.; Cottier, H.; Cronkite, E.P.; Laissue, J.A. *Cell Tissue Kinet.;* **10**: 57-69(1977).

Cortical thymocytes of young adult mice were labeled in situ with radioactive DNA precursors. As a result of cell emigration and cell death, total thymic radioactivity decreased within 8 days to 10% or less of that present on day 1. Accumulation of thymic migrants in peripheral lymphoid organs was estimated by computing the net thymus-derived radioactivity in these tissues. Thymic cell death was assessed by comparing values obtained with ^{125}I-UdR to those acquired with ^{3}H-TdR. The results indicate that cortical thymocytes migrate to the spleen, mesenteric lymph node, femurs and intestine; nevertheless, only a small fraction of the activity originally present in the thymus was recovered in these organs; the vast majority of newly formed cortical thymocyes apparently die after a relatively short life span. Exclusive of the fraction which dies in situ, evidence for thymocyte death is seen in bone marrow; however, most migrants appear to terminate in the intestine.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 42497, 42498, 42499, 42531, 43139

43678 (PB—272917) **Beef cattle feedlot runoff and control in eastern Nebraska. Final report.** Schram, L.P. (Schram (L.P.) Food Lot, Inc., Papillion, Nebr. (USA)). Aug 1977. 41p. NTIS PC A03/MF A01.

This study was initiated to determine operational characteristics of runoff control facility components for beef cattle feedlots. A runoff control facility was designed and constructed for a 3,000 head capacity feedlot in eastern Nebraska. Components of the runoff control facility included debris basins inside the pen and outside the pen, a holding pond, and a disposal system. Results indicated that design volumes for the debris basins and holding ponds were effective in controlling runoff from the lots caused by snowmelt and rainfall for climatic conditions within eastern Nebraska. Characteristics of runoff transported solids from this large lot compared favorably with values developed earlier on small research lots. All values for total and volatile solids, electric conductivity, pH, nitrogen, phosphorus, and COD were within published ranges.

43679 (PB—274619) **AGRIMOD: a dynamic simulation model of the U.S. food production system. Part I. crop production. Final report.** Levis, A.H.; Ducot, E.R.; Sidenblad, K.M.; Levis, I.S. (National Science Foundation, Washington, D.C. (USA). Office of System Integration and Analysis). Mar 1977. 135p. NTIS PC A07/MF A01.

AGRIMOD is a dynamic simulation model of the U.S. food production system designed for the analysis of the implications of alternative national policies on the food supply, the effects of possible natural resource and energy constraints on food supply and prices, the impacts of policies on imports, exports, and reserves, and the effects of technological change. The model consists of seventeen submodels fully integrated through material and information flows into four sectors and three markets. In this report, the Pre-production Sector, the Farm Input Market, and the Crop Production Sectors are described in detail. Included are the submodels for regional land development and use, the crop producer's resource allocation problem, expected prices, fertilizer demand, farm input market, and realized crop production. The basic inputs considered are land, fertilizer, capital, labor, fuel and energy. Also included is a stochastic model for evaluating crop/location specific effects of weather on yields. The production cycle is an annual one with a multi-stage sequence of events within each cycle. The period over which the model and its data base are operational is 1955 to 1990.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 43630

43680 Multiple thymine dimer excising nuclease activities in extracts of human KB cells. Cook, K.H.; Friedberg, E.C. (Stanford Univ., CA). *Biochemistry;* **17**: No. 5, 850-857(7 Mar 1978).

Crude extracts of human KB cells grown in suspension culture contain enzyme activity that catalyzes the preferential excision of thymine-containing pyrimidine dimers from uv-irradiated E. coli DNA specifically incised adjacent to dimer sites. Fractionation of KB cell crude extracts reveals the presence of three such activities with distinct affinities for both DEAE-cellulose and phosphocellulose. One of the activities (activity B) is distinguished by its S/sub 20,w/ (2.6) and isoelectric point (9.0) from the other two (activities A and C) which have similar S/sub 20,w/'s (3.0 to 3.2) and isoelectric points (6.0). All three differ in their extent of stimulation by divalent cation and inhibition by NaCl or a sulfhydryl group inhibitor. These results indicate that multiple 5′ → 3′ dimer excision nuclease activities exist in human cells; however, there is as yet no direct evidence that these enzymes are functional in nucleotide excision repair in vivo.

43681 Enzyme activity and allosteric characteristics of gamma-irradiated solid aspartate transcarbamylase. Bigler, W.N.; Tolbert, B.M. (Inst. of Tech., Rochester, NY). *Radiat. Res.;* **72**: No. 3, 371-383(Dec 1977).

Aspartate transcarbamylase purified from E. coli was lyophilized, irradiated in vacuo with γ radiation from a cesium-137 source, redissolved in buffer under a nitrogen atmosphere, and assayed for enzyme activity. Lyophilized and redissolved enzyme had normal catalytic and allosteric kinetic characteristics. The average D_{37} observed with saturating substrate, 25 mM aspartate, was 4.1 Mrad. With less than saturating substrate, 5 mM aspartate, the activity increases from zero to 1.6 Mrad and then decreases with a D_{37} of 7.2 Mrad. Inclusion of 1 mM CTP, an allosteric inhibitor, in the 5 mM aspartate assays results in a more pronounced maximum in the activity curve occurring at slightly higher dose, 2.2 Mrad. Inhibitability by CTP has a D_{37} of 2.3 Mrad with doses below the activity maximum. Enzyme lyophilized in the presence of 1 mM CTP has a D_{37} of 2.9 Mrad. ATCase activity changes caused by irradiation of lyophylized bacteria were qualitatively like the changes observed in the detailed studies with the purified enzyme. Apparent radiation sensitivities of ATCase in lyophilized bacteria were observed to vary with the technique used to disrupt the resuspended bacteria.

43682 Sedimentation and subunit interactions of gamma-irradiated solid aspartate transcarbamylase. Bigler, W.N.; Tolbert, B.M. (Rochester Inst. of Tech., NY). *Radiat. Res.;* **72**: No. 3, 384-401(Dec 1977).

Gamma-irradiated solid aspartate transcarbamylase (ATCase) was dissolved and tested for radiation-induced subunit dissociation and aggregation by polyacrylamide gel electrophoresis and sucrose density gradient centrifugation. High-molecular-weight aggregates of ATCase were spontaneously dissociated by irradiation but neither native ATCase nor its catalytic subunit spontaneously dissociated to their individual protein chains after 8.5-Mrad irradiation. Equilibration of catalytic subunits between oligomeric ATCase and free catalytic subunits occurs without net release of regulatory subunits from the oligomeric ATCase. When 8.5-Mrad-irradiated oligomeric ATCase was equilibrated with unirradiated catalytic subunits the oligomer was disrupted and both irradiated catalytic and regulatory subunit sedimentation peaks were obtained. Radiation damage to subunit aggregation interactions was also demonstrated by mercurial treatment which caused the catalytic subunit protein to sediment at rates corresponding to a lower molecular weight than the three-polypeptide trimer of the catalytic subunit. There was no evidence of radiation-induced intersubunit covalent bonding.

43683 γ irradiation of Bowman—Birk soybean proteinase inhibitor. Wandell, J.L.; Kay, E. (Univ. of California, Los Angeles). *Radiat. Res.;* **72**: No. 3, 414-426(Dec 1977).

Radiation damage to Bowman-Birk soybean proteinase inhibitor was studied in dilute aqueous solutions containing: (a) air, (b) N_2O plus KBr, and (c) N_2O plus KCNS. The degradation of tyrosines, monitored by changes in ultraviolet absorption and circular dichroism (CD) spectra of irradiated inhibitor, led to the loss of chymotrypsin-inhibitory activity without affecting antitrypsin activity. Of two tyrosyl residues in the inhibitor, Tyr 45, located next to the antichymotrypsin site, was shown to be essential to chymotrypsin-inhibitory activity. Radiation damage to Tyr 59 had no effect on either of the antiproteinase activities. The loss of trypsin-inhibitory activity paralleled decrease in disulfide Cd. The breakage of disulfide bonds was confirmed by the p-chloromercuribenzoate assay for sulfhydryl groups. However, the exact role of disulfide bonds in antitryptic activity, other than the maintenance of conformational integrity, is not apparent. It seems more likely that the loss of trypsin-inhibitory activity is due to damage in other amino acid(s), although the degradation of tyrosine (2 residues) and histidine (1 residue) did not affect antitryptic activity.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 43709

43684 (BNWL—2100(Pt.4)) **Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.** Nielsen, J.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1977. Contract EY-76-C-06-1830. 120p. Dep. NTIS, PC A06/MF A01.

Separate abstracts were prepared for each of the 12 sections.

43685 (BNWL—2100(Pt.4), pp 11-22) **Radiation dosimetry and radiation biophysics.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

The radiation biophysics program tests or makes use of the theoretical developments and gathers information needed for the theories by experiments on cellular systems. Results are reported from measurements of the temperature variation of the parameters for the fraction of cells surviving irradiation that led to identification of an enzymatic recovery process and a competitive process for radiosensitivity. A mechanically controlled microscope with a wide viewer and recorder was assembled to permit precision survival measurements at low doses. A study of the microdosimetry of radiation nonequilibrium for neutrons showed the departures from equilibrium were small. As part of work on modeling the changes in radiation sensitivity during the cell cycle a simple, but exactly solvable, model of the cycle was developed to serve as test system for more complicated, but approximate, models. Analysis of a number of models for the effects of the dose rate on cells showed that all but one of them could be eliminated by experiments on Chlamydomonas reinhardi.

43686 (PB—274793) **RF cell culture irradiation system with controlled temperature and field strength.** Guy, A.W. (Washington Univ., Seattle (USA). Bioelectromagnetics Research Lab.). Jun 1977. 55p. NTIS PC A04/MF A01.

A unique RF cell culture irradiation system with controlled temperature and field strength is described, which was used in determining human RF exposure thresholds in the frequency range D.C. to 100 MHz. The system can produce electric field strengths up to 100 V/cm from D.C. to 1000 MHz in a 5-ml sample of culture medium. The culture medium temperature can be controlled and measured up to 100 MHz by monitoring the feedline impedance, which is dependent on culture medium temperature. Constant temperatures below 37C can be maintained at field strengths in excess of 25 V/cm. The information that can be obtained with the use of this system is needed to fill information gaps for standards criteria development.

43687 **Repair deficient human disorders and cancer.** Setlow, R.B. (Brookhaven National Lab., Upton, N.Y. (USA)). *Nature (London);* **271**: No. 5647, 713-717(23 Feb 1978).

This review article states that study of the repair of damage to DNA in affected mammalian cells can lead not only to a knowledge of which environmental agents, including radiation, are injurious to living creatures, but also to an understanding of what reaction products in DNA are potentially carcinogenic and which tissues are most sensitive. It has been shown that individuals defective in repair are cancer-prone and knowledge of the molecular nature of the defects leads to the prediction that unrepaired damage to DNA has a high carcinogenic potential. The complexity of carcinogenesis, however, indicates that not all cancers arise from defects in repair. The rate of DNA repair, however, compared with other cellular processes, should be an important parameter in carcinogenesis, and an understanding of the control and kinetics of repair processes is of great importance.

INTERNAL SOURCE

REFER ALSO TO CITATION(S) 43684

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

43688 **Induced radioresistance in four strains of Escherichia coli, two with lambda lysogens.** Pollard, E.C. (Pennsylvania State Univ., University Park); Fluke, D.J. *Biophys. J.;* **22**: No. 3, 431-438(Jun 1978).

Cells of E. coli that are $recA^+$ and lex^+ show a phenomenon of induced radioresistance. A preexposure to ultraviolet light, or ionizing radiation followed by incubation to allow protein synthesis, followed by treatment with rifampin to prevent further induction, renders the cells resistant to further doses of radiation. When this is attempted with lambda lysogens of the same strains, no radioresistance is seen, even though the preexposure is too small to induce lambda itself. If the lysogens are ind^-, namely lambda C1857, about the normal radioresistance can be developed by pretreatment. These findings suggest that the lambda repressors can bind to single-strand breaks caused by the inducing agent and can modify the course of induction.

43689 **Relation of ultraviolet light mutagenesis to a radiation-damage inducible system in Escherichia coli.** Pollard, E.C. (Pennsylvania State Univ., University Park); Person, S.; Rader, M.; Fluke, D.J. *Radiat. Res.;* **72**: No. 3, 519-532(Dec 1977).

Revertants produced by ultraviolet light (uv) were shown to follow a square-law dependence on fluence up to about 0.5 J/m^2, after which the dependence became closer to linear. This behavior can be associated with an induction process, and a new way of expressing mutation data is presented that allows one to estimate the fraction of cells in a population that is inducible after exposure to a particular uv fluence. Comparison with two other kinds of radiation-induced behavior (induction of inhibition of post-irradiation DNA degradation and induced radioresistance) shows that the fluence dependence of induction is similar in all three cases. A predose with ionizing radiation followed by an incubation period and subsequent exposure to a graded set of uv fluences at 265 nm gave an increase in the number of revertants and a more linear dose dependence. The same result was obtained if the predose was a uv fluence at 265 nm and the graded set of doses was at 313 nm, a wavelength which by itself produces very few revertants. These changes in the mutagenic response were also consistent with the induction of a mutation-potentiating system by the predose. Ultraviolet-produced mutations in the presence or absence of an ionizing radiation predose appear to be due to $C \rightarrow T$ changes in the bacterial genome (C and T denote cytosine and thymine, respectively).

43690 (ANL-Trans—1132) **Effect of near-visible light on Haemophilus influenzae.** Espinosa-Lara, M.; Cabrera-Juarez, E. Translated from *Rev. Latinoam. Microbiol.;* **14**: 103-106(1972). 10p. Dep. NTIS, PC A02/MF A01.

The near visible light (330—400 nm) in the presence of air and without exogenous photosensitizers had a lethal and mutagenic action on Haemophilus influenzae. The lethal effect showed two slopes, the first coinciding with a slow increase in the mutation frequency and the second with a rapid one. The mutation frequency rose to 16 to 18 times the value of the control. The effective wavelength of the light was between 330 to 400 nm.

RADIATION EFFECTS ON ANIMALS

43691 (PB—273111) **Health effects of alpha-emitting particles in the respiratory tract.** (National Research Council, Washington, D.C. (USA). Assembly of Life Sciences). Oct 1976. Contract EPA-68-01-2230. 129p. NTIS PC A07/MF A01.

The report presents a summary and analysis of current knowledge concerning health effects of alpha-emitting particles in the respiratory tract. The findings of the Committee were: (1) Lung cancer mortality in experimental animals can be adequately accounted for by averaging the absorbed alpha radiation dose over the entire lung; (2) Human data suggests the radiocarcinogenic sensitivity of the tracheobronchial region of the lung is greater than that of the alveolar region and the cancer risk for alpha irradiation of the alveolar region would not be underestimated by using the risk factors obtained for the tracheobronchial region; (3) Experimental

evidence suggests the carcinogenic response is more a function of the amount of radioactivity in the lung than its distribution.

MAN

REFER ALSO TO CITATION(S) 43704

43692 (AD-A—047269) **Isodose line field of cosmic ray heavy nuclei tracks in tissue. Report No. 3, (final), October 1976—August 1977.** Schaefer, H.J. (West Florida Univ., Pensacola (USA)). 1 Oct 1977. Contract N00014-76-C-0544. 17p. NTIS PC A02/MF A01.

The microdosimetric structure of a track of a heavy nucleus of Z = 26 (Fe) for the terminal section of 12 cm in tissue as it follows from theory is presented in form of the isodose line field. The similarities and differences of the field as compared to gamma rays or alpha particles are pointed out. It is shown that only the core of the last few millimeters of the Fe track in tissue differs substantially from conventional radiations in exhibiting local dose levels larger by several orders of magnitude. Since the mode of action of such 'microbeam' hits on living matter is as yet incompletely understood, measuring exposure with a dosimetric unit similar to the rem is at present beyond reach. Therefore, record keeping on personnel exposures remains limited, for the time being, to the physical parameters. As radiobiological research with heavy ions progresses, it should eventually be possible to evaluate such records in terms of 'dose equivalents'.

43693 (AD-A—047300) **Radiobiology. Report bibliography May 1952—June 1977.** (Defense Documentation Center, Alexandria, Va. (USA)). Nov 1977. 265p. (DDC/BIB—77-12). NTIS PC A12/MF A01.

This bibliography contains unclassified-unlimited citations on the effects of radiation on living organisms; the effect of artificial and natural radiation on the heart, lungs, nervous system, and other physiological systems are included. The four computer-generated indexes provided are Corporate Author-Monitoring Agency, Subject, Title and Personal Author.

43694 (BNL—50797) **External radiation survey and dose predictions for Rongelap, Utirik, Rongerik, Ailuk, and Wotje Atolls.** Greenhouse, N.A.; Miltenberger, R.P. (Brookhaven National Lab., Upton, N.Y. (USA)). 13 Dec 1977. Contract EY-76-C-02-0016. 28p. Dep. NTIS, PC A03/MF A01.

External radiation measurements were made at several atolls in the northern Marshall Islands, which are known or suspected to have been the recipients of tropospheric fallout during the Pacific Testing Programs. Sufficient data were available to ascertain realistic dose predictions for the inhabitants of Rongelap and Utirik Atolls where the 30 year integral doses from external sources exclusive of background radiation were 0.65 and 0.06 rem respectively. These estimates are based on realistic life-style models based on observations of each atoll community. Ailuk and Wotje Atolls were found to be represenatives of regional background radiation levels.

43695 (DOE/EV—0011/9) **Ninth annual report of radiation exposures for DOE and DOE contractor employees, 1976.** (Department of Energy, Washington, D.C. (USA). Div. of Operational and Environmental Safety). Apr 1978. 49p. Dep. NTIS, PC A03/MF A01.

In 1968, the U.S. Atomic Energy Commission (AEC) established a program for reporting certain occupational radiation exposure information to a central radiation records repository maintained at the Union Carbide Computing Technology Center, Oak Ridge, Tennessee. Annual summaries (WASH-1350-R1 through WASH-1350-R6) were reported for the years 1968—1973 and included data on AEC contractor employees as well as employees of companies in the private sector licensed by the AEC. In January 1975, the operational functions of the AEC, including the maintenance of records on the occupational radiation exposure of contractor employees were transferred to the Energy Research and Development Administration (ERDA) and the AEC's regulatory functions, including the reporting of information on the occupational radiation exposure of licensees were transferred to the Nuclear Regulatory Commission (NRC). Previous AEC licensees now report to NRC while the contractors reported to ERDA. Radiation exposure data for AEC/ERDA and AEC/ERDA contractor employees for 1974 and 1975 were reported in ERDA 76/119 and ERDA 77-29. This report contains the 1976 data for ERDA and ERDA contractor employees.

43696 (N—78-11702) **Provisional standards of radiation safety of flight personnel and passengers in air transport of the civil aviation.** (National Aeronautics and Space Administration, Washington, D.C. (USA)). Oct 1977. Translated from Vremennyye Normy Radiatsionnoy Bezopasnosti Letnogo Personala I passazhirov Vozdushnogo Transporta Grazhdanskoy Aviatsil. (NASA-TM—75052). 20p. NTIS PC A02/MF A01.

Provisional standards for radiation affecting passenger aircraft are considered. Agencies responsible for seeing that the regulations are enforced are designated while radiation sources and types of radiation are defined. Standard levels of permissible radiation are given and conditions for radiation safety are discussed. Dosimetric equipment on board aircraft is delineated and regulation effective dates are given.

43697 (PB—274202) **Documented personnel exposures from airport baggage inspection systems.** Sensintaffar, E.L.; Moss, C.E.; Parr, W.H. (National Inst. for Occupational Safety and Health, Cincinnati, Ohio (USA). Div. of Biomedical and Behavioral Science). Oct 1976. 16p. (DHEW/PUB/NIOSH—77/105). NTIS PC A02/MF A01.

Whole-body and wrist exposure to X-radiation from airport baggage inspection systems is documented. Specially designed badges were worn by 72 security personnel for 2-week intervals at 5 major United States airports. At least one model of each baggage X-ray system in use during the study was investigated. The data represent the total exposure received by security personnel under normal working conditions. Measurements of the X-ray exposures over the 2-week period ranged from 0 to 16.4 milliroentgen with little difference noted between whole-body and wrist exposures. The results indicate that no measured dose equivalent exceeded the limits specified in the Occupational Safety and Health Administration standard for ionizing radiation.

43698 (PNL—2621) **Radiation dose to construction workers at operating nuclear power plant sites. Annual report, August 1976—July 1977.** Endres, G.W.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 83p. Dep. NTIS, MF A01.

Portions of document are illegible.

Radiation exposures received by most construction workers at nuclear power plant sites have not been measured routinely because field surveys have indicated exposure levels below the point for which monitoring is required. As a consequence, the dose to individuals and groups of workers is not known to the degree desired for adequate environmental impact assessment. This study was developed to measure and evaluate radiation exposure and exposure rates received by construction workers at various reactor sites where one or more reactors are operating while construction is proceeding on one or more additional reactors. This study is providing a data base from which a realistic assessment of radiological impact can be made for the construction workers of proposed multiunit nuclear power plants and to help arrive at a decision as to whether increased control of the radiation exposure of these workers is warranted. Four nuclear sites were included in this study after receiving approval of the operating utilities. Data from thermoluminescent personnel dosimeters and environmental dosimeters showed that the construction workers receive very little exposure above background.

43699 **Irradiation-related thyroid cancer.** Meckelnburg, R.L. (Wilmington Medical Center, DE); Whitney, L.W. *Del. Med. J.;* **49**: No. 3, 135-136(Mar 1977).

The Division of Cancer Control and Rehabilitation of NCI has posted information for physicians with regard to irradiation-related thyroid cancer. A summary about late effects of radiation of head and neck in infancy and childhood points out that irradiation of the thyroid gland during various therapeutic regimens is now recognized as a possible cause of development of both benign and malignant thyroid tumors many years later. The often benign and slow growing tumors may develop up to 35 years after treatment. They can be removed surgically. The greatest problem is identifying persons who received radiation in childhood. Careful inspection and palpation of the gland are recommended. Radioisotope scans may be helpful since cold nodules are more likely to be carcinomas. If a nodule is suspected on palpation, administrating thyroid hormone may shrink the gland and make the nodule more prominent. Some feel that hormone given to asymptomatic patients with irradiation history may help prevent tumor development. At-risk individuals and those who have been treated surgically for thyroid malignancy should be examined every 1—2 years. Surgical exploration should be considered for thyroid nodules. The nuclear medical section of the Wilmington Medical Center has established a tumor registry for thyroid tumors and has recorded 96 patients who are being followed by a special thyroid registry. Recommendations concerning identification of patients at-risk, detection, and scintiscanning are given.

43700 **Prior immobilization and positioning for more efficient radiotherapy.** Kligerman, M.M.; Hogstrom, K.R.; Lane, R.G.; Somers, J.W. (Univ. of New Mexico, Albuquerque). *Int. J. Radiat. Oncol., Biol. Phys.;* 2: No. 11-12, 1141-1144(1977).

Trials of the prior immobilization and positioning (PIP) system were carried out for pion patients at the Los Alamos Scientific Laboratory, Los Alamos, N.M., to demonstrate a more efficient method of beam utilization. In the trials patients entered the staging area, where they were placed in immobilizing casts in a treatment module. Localizing lasers identical to those in the treatment room defined the treatment portal and aligned bolus and collimator. Patients thus positioned and immobilized with necessary bolus and

collimating devices in place were transported by stretcher into the treatment room and keyed by laser coordinates under the beam, which can be activated immediately. The PIP prototype at Los Alamos has reduced from 20 min to 4 min the interval required to position successive patients under the vertical fixed beam. Using the PIP system with current supervoltage generators and treatment couches, approximately 10 patients could be treated per hr as compared with 4 or 5 patients currently managed. This would reduce the cost per treatment by approximately half. PIP also makes feasible the use of computerized treatment. Any room of reasonable size near the treatment room could accommodate PIP procedures.

VERTEBRATES

43701 (AD-A—046165) **Origin of cataracts in the lens from infrared laser radiation. Annual progress report, 1 September 1976—31 August 1977.** Wolbarsht, M.L.; Orr, M.A.; Yamanashi, B.S.; Zigler, J.S.; Matheson, I.B.C. (Duke Univ., Durham, N.C. (USA). Eye Center). 24 Oct 1977. Contract DAMD17-74-C-4133. 22p. NTIS PC A02/MF A01.

Changes in lens proteins following exposure to IR irradiation have been used to detect the earliest changes possible in cataract formation. Rat lenses maintained in organ culture have been used to determine the temperature which will initiate cataractogenesis. Exposures from a CW neodymium laser (1060 nm) were used to determine what energy levels are necessary to produce protein changes. These changes have been characterized by thin layer isoelectric focused electrophoresis and sodium dodecyl sulfate electrophoresis. (Author)

43702 (AD-A—047766) **Effect of staphylococcal enterotoxin B on cardiorenal functions and survival in x-irradiated rhesus macaques. Interim report.** Liu, C.T.; Griffin, M.J.; Hilmas, D.E. (Army Medical Research Inst. of Infectious Diseases, Frederick, Md. (USA)). 10 Nov 1977. 31p. NTIS PC A03/MF A01.

Pretreatment of monkeys with nonlethal total-body x-irradiation (400 R) prolonged survival time from an average of 15 to 101 hours after intravenous (IV) inoculation of 50 micrograms/kg of staphylococcal enterotoxin B (SEB). Radiation exposure per se did not produce detectable cardiorenal changes. However, the longer survival after SEB challenge in x-irradiated monkeys was associated with improved cardiorenal functions when compared to nonirradiated monkeys given the same dose of SEB. Total-body radiation exposure 4 days prior to IV SEB inoculation prevented typical SEB-induced decreases (where measured at 5 hours) in cardiac output, stroke volume, concentration of solute-free water, clearance of para-amino-lippurate, osmolar clearance, and urine flow, as well as increases in total peripheral and renal resistance. A theory concerning the significance of radiation-induced leukopenia on modification of SEB-induced cardiorenal functions is postulated.

43703 (CONF-780306—7) **Relationship of dose rate and total dose to responses of continuously irradiated beagles.** Fritz, T.E.; Norris, W.P.; Tolle, D.V.; Seed, T.M.; Poole, C.M.; Lombard, L.S.; Doyle, D.E. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 24p. Dep. NTIS, PC A02/MF A01.

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Young-adult beagles were exposed continuously (22 hours/day) to ^{60}Co γ rays in a specially constructed facility. The exposure rates were either 5, 10, 17, or 35 R/day, and the exposures were terminated at either 600, 1400, 2000, or 4000 R. A total of 354 dogs were irradiated; 221 are still alive as long-term survivors, some after more than 2000 days. The data on survival of these dogs, coupled with data from similar preliminary experiments, allow an estimate of the LD_{50} for γ-ray exposures given at a number of exposure rates. They also allow comparison of the relative importance of dose rate and total dose, and the interaction of these two variables, in the early and late effects after protracted irradiation. The LD_{50} for the beagle increases from 258 rad delivered at 15 R/minute to approximately 3000 rad at 10 R/day. Over this entire range, the LD_{50} is dependent upon hematopoietic damage. At 5 R/day and less, no meaningful LD_{50} can be determined; there is nearly normal continued hematopoietic function, survival is prolonged, and the dogs manifest varied individual responses in other organ systems. Although the experiment is not complete, interim data allow several important conclusions. Terminated exposures, while not as effective as radiation continued until death, can produce myelogenous leukemia at the same exposure rate, 10 R/day. More importantly, at the same total accumulated dose, lower exposure rates are more damaging than higher rates on the basis of the rate and degree of hematological recovery that occurs after termination of irradiation. Thus, the rate of hematologic depression, the nadir of the depression, and the rate of recovery are dependent upon exposure rate; the latter is inversely related and the former two are directly related to exposure rate.

43704 (CONF-780306—8) **Analytical approaches to and interpretations of data on time, rate, and cause of death of mice exposed to external gamma irradiation.** Grahn, D.; Sacher, G.A.; Lea, R.A.; Fry, R.J.M.; Rust, J.H. (Argonne National Lab., Ill. (USA)). 13 Mar 1978. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Young adult male and female mice of inbred strains, A, BALB/c, C57BL/6, and C57L, and B6CF$_1$ and F$_2$ hybrids were exposed to daily duration-of-life external ^{60}Co γ irradiation. Age at death was recorded, and most decedents were necropsied to ascertain occurrence of major types of tumors. Age- and cause-specific mortality or incidence rates were derived, and their regressions on age were fitted with polynomial equations by least-squares procedures. Age-specific and age-adjusted integrated lifetime risk in excess of the control population was expressed as the mortality ratio (irradiated/control). Linear and nonlinear functions and widely different life expectancies can be accommodated by this technique. These basic actuarial statistics provide a means for comparative analysis of dose-response functions, sex and genetic variables, relative vs. absolute risk, protraction or dose-rate factors, and major contributing causes of excess risk. They also provide a basis for extrapolation to man. As examples, life shortening in days per rad (4 days/100 rads accumulated) is generally independent of sex, genotype, and daily dose rate. The integrated average lifetime risk of death related to all tumors (0.025%/rad) is largely independent of sex, genotype and dose-rates <12 rads/day, despite the fact that tumor incidence varies by a factor of 2 to 3 among genotypes. At low exposure rates, tumor-related mortality accounts for 80% of the excess risk, and life shortening is a function only of accumulated dose, independent of dose rate below 12 rads/day. The radiobiological effectiveness for low daily exposure levels is less than that for single exposures by a factor of 5 to 10. Life shortening following low daily exposure rates is induced at the rate of .03 to .06 days/R for the mouse, which extrapolates to about 1 to 2 days/R for man.

43705 (PB—274780) **Ocular ultraviolet effects from 295 nm to 400 nm in the rabbit eye.** (Houston Univ., Tex. (USA). Coll. of Optometry). Oct 1977. Contract PHS-CDC-99-74-12. 90p. NTIS PC A05/MF A01.

Pigmented rabbit eyes were irradiated with ultraviolet in 5 nanometer intervals from 290 to 320 nanometers and in 10 nanometer intervals from 325 to 400 nanometers. Ocular tissues were studied with the electron microscope to localize and describe the morphology of the damage. The upper limit of the action spectrum for cornea was established at 320 nanometers. The most efficient waveband for lenticular damage was 300 nanometers which gave a radiant exposure threshold of 0.15 joules per square centimeter. The lenticular radiant exposure threshold produced transient lenticular opacities which disappeared within 24 hours to 2 weeks. Permanent cataracts occurred at radiant exposure levels approximately twice the threshold exposure. Radiant exposures of twice the threshold exposure for the cornea resulted in irreversible corneal damage in the form of stromal haze, stromal opacities, endothelial changes, and anterior uvitis. Preliminary studies on a primate at 300 nanometers gave a corneal threshold and a lens threshold of about 0.01 and 0.12 joules per square centimeter, respectively.

43706 (PB—274880) **Ocular ultraviolet effects from 295nm to 335nm in the rabbit eye.** (Houston Univ., Tex. (USA). Coll. of Optometry). Oct 1976. Contract PHS-CDC-99-74-12. 63p. NTIS PC A04/MF A01.

Pigmented rabbit eyes are exposed to 6.6 nanometer bandpass ultraviolet radiant energy in 5 nanometer steps from 295 to 320 nanometers and at random intervals above 320. Corneal and lenticular damage is assessed and classified. Corneal threshold radiant exposure rises rapidly from 0.022 joules per square centimeter at 300 nanometers to 10.99 joules per square centimeter at 335 nanometers. Radiant exposure exceeding two times the corneal threshold radiant exposure result in irreversible corneal damage. Lenticular damage is limited to wavebands above 295 nanometers. There is an action spectrum for the lens which begins at 295 nanometers and extends to about 315 nanometers. Permanent lenticular damage occur at radiant exposure levels approximately twice the threshold for lenticular radiant exposure.

43707 **Neutron carcinogenesis. Dose and dose-rate effects in BALB/c mice.** Ullrich, R.L.; Jernigan, M.C.; Storer, J.B. (Oak Ridge National Lab., TN). *Radiat. Res.;* **72**: No. 3, 487-498(Dec 1977).

The influence of dose and dose rate on the tumorigenicity of neutrons was investigated in female BALB/c mice exposed to various doses of neutrons at dose rates of 5 and 25 rad/min or 1 rad/day. The tumors that were most sensitive to induction after neutron exposures included malignant lung adenocarcinomas, mammary adenocarcinomas, and ovarian tumors. For these three tumor types, increased incidences were observed after as little as 5-10 rad of neutrons delivered at a high dose rate. However, after low-dose-rate neutron exposures, different dose-response relationships were observed. Neutron irradiation at low dose rates was less effective than

at high dose rates in inducing ovarian tumors at all doses tested. For malignant lung tumors and mammary tumors, on the other hand, the data suggested that the low dose rate was less effective than the high dose rate at low total doses, but more effective at high total doses.

43708 Leukemia and lymphoma in irradiated parabiont rats. Warren, S.; Chute, R.N.; Porter, M.W.; Brown, C.E.; Gates, O. (Cancer Research Inst., Boston). *Radiat. Res.;* **72**: No. 3, 512-518(Dec 1977).

Leukemia and lymphoid tumors each have a 2 percent spontaneous rate in NEDH rats. Rats are less prone to such tumors than mice. Parabiosis of syngeneic rats permits one partner to survive a whole-body x-ray exposure of 1000 R if the other partner is shielded. Parabiosis alone induced a slight increase in the rates of incidence of both leukemia and solid lymphoid tumors, to about 5 percent. Exposure of one parabiont partner to 1000 R did not increase the incidence rates of these tumors significantly in either partner and sharply decreased the incidence rate of lymphosarcoma in female pairs. Monocytoid and myeloid leukemias were the more common types. Leukemia was often but not always shared by both partners of a pair. The solid lymphoid tumors tended to respond similarly following parabiosis and radiation. These tumors were usually restricted to one partner. Their incidence rates did not differ significantly between the irradiated and shielded partners, for lymphosarcoma 0.3 percent in the irradiated and 1.0 percent in the shielded and for reticulum cell sarcoma 1.1 and 1.5 percent, respectively.

43709 Biological effects of 15 MeV neutrons. Phillips, T.L.; Fu, K.K. (Univ. of California, San Francisco). *Int. J. Radiat. Oncol., Biol. Phys.;* **1**: No. 11-12, 1139-1147(1976).

To study the RBE of 15 MeV neutrons for normal tissues, the responses of jejunal crypt cells, lung, and esophagus to 15 MeV neutrons generated from a deuterium-tritium neutron generator were compared with responses to ^{137}Cs (cesium) γ- or 300 kVp x-rays in the mouse. For jejunal crypt cell survival, the RBE was 1.5 at a survival of 10 crypt cells per circumference. The RBE for pulmonary lethal dose LD/sub 50/160/ and esophageal LD/sub 50/28/ was 1.2 and 3.02, respectively. Data available in the literature on the effects of 15 MeV neutrons on tumor and normal tissues were reviewed; additional studies which should be performed prior to the clinical use of 15 MeV deuterium-tritium neutron generators are suggested.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

REFER ALSO TO CITATION(S) 43695

MAN

REFER ALSO TO CITATION(S) 43581, 43582, 43698

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 43595

ANIMALS

43710 (BNWL—2100(Pt.4), pp 23-29) **Dosimetry of particulate sources in the lung.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

Practical methods were developed for calculating microdosimetric distributions for soft tissue and for lung tissue in which plutonium or other alpha-emitting elements are deposited, particularly when deposited as particulates, to aid in correlating and extrapolating radiation effects measured at different levels of exposure and in different species. Computational methods were developed and tested and cell and tissue models in which those methods were applied are described. Single-event energy depositions due to alpha particles were studied by Monte Carlo methods. A computer program for combining the single-event depositions due to any distribution of small particulates in soft tissue was prepared.

43711 (BNWL—2100(Pt.4), pp 83-84) **Dosimetry of internal emitters.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 4. Physical and technological programs.

Results are reported from studies on the radiation dose to G.I. tract from ingested insoluble β emitters. Development of methods for improving the dose to the crypt cells in the G.I. tract from the ingestion of insoluble beta emitters was continued. The animals were exposed to mixtures of radioisotopes to closely simulate the energy mix of the effluent of a reactor catastrophe. These experiments verified the previously derived LD_{50} values for a spectrum of beta energies based mainly on the results of exposure to ^{106}Ru-^{106}Rh. Organ and whole-body dose to rodents and beagle dogs from inhaled ^{85}Kr gas in experiments were measured to elucidate the biologic effects of potential gaseous reactor effluents. Dose and organ burden modeling along ICRP-2 methodology is provided to the $^{239}Pu(NO_3)_4$ experiments with beagle dogs as a distinct and additional effort for intercomparison with a separate analog modeling methodology. Considerable effort was applied to calculating and measuring the combined neutron and gamma doses to swine ureter, bladder, colon, and other organs from implanted cervical sources of ^{252}Cf and ^{226}Ra. The neutron RBE for early changes in the tissues at risk in the treatment of cervical cancer was determined to lie between 6.2 and 6.8 whereas the RBE for delayed effects appears to be somewhat decreased, most likely a result of tissue repair. These studies continue in order to more accurately fix the neutron RBE for delayed effects and to determine the limitations of implanted neutron sources for treating cervical cancer.

43712 Leaching of radionuclides from neutron-activated talc in serum and in dilute hydrochloric acid. Wilkerson, C.L.; Wehner, A.P.; Rancitelli, L.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). *Food Cosmet. Toxicol.;* **15**: No. 6, 589-593(Dec 1977).

When neutron-activated talc was suspended in bovine serum, 0.5% of the ^{60}Co and 3.1% of the ^{46}Sc occurring in the sample was found in the supernatant of the centrifuged and filtered suspension. A maximum of about 0.5% of each radionuclide can be attributed to small particles passing through the filter. This indicates that very little ^{60}Co and about 2.5% ^{46}Sc leached from the talc. The findings indicate that from the pulmonary talc burden of about 45 μg observed in a previously conducted pulmonary deposition, translocation, and clearance study, the equivalent of about 0.2 or 1.1 μg talc may have leached, depending on whether ^{60}Co or ^{46}Sc data were used for this computation. Leaching effects on the lung burden thus appear to be negligible. When neutron-activated talc was suspended in 2 N-HCl, from 2 to 5% of the induced ^{60}Co, ^{51}Cr, ^{59}Fe, and ^{46}Sc was removed, primarily by leaching. This suggests that leaching of radionuclides from talc may take place in the acid environment of the stomach. This leaching and the subsequent absorption of the radionuclide in the intestinal tract could account for the quantities of ^{60}Co found in the urine of the hamsters in the earlier study.

43713 Gastrointestinal absorption, tissue distribution, and excretion of ^{95}Nb in newborn and weanling swine and sheep. Mraz, F.R.; Eisele, G.R. (Comparative Animal Research Lab., Oak Ridge, TN). *Radiat. Res.;* **72**: No. 3, 533-536(Dec 1977).

Carrier-free ^{95}Nb in oxalic acid was administered orally by intubation or intravenously (iv) to sheep and swine 6-18 hr after birth or 3 weeks after weaning. Animals were sacrificed 3 days later and the ^{95}Nb contents of several internal organs, gastrointestinal (GI) contents, and excreta examined. Considerably more ^{95}Nb was absorbed by animals receiving ^{95}Nb orally between 6 and 18 hr after birth (18 to 50 percent of administered dose) than by those receiving it after weaning (0.06 to 0.5 percent). The skeleton and GI tissues of iv-injected neonates contained more ^{95}Nb than iv-injected weanlings, but no differences were observed in total-body ^{95}Nb. While almost all the ^{95}Nb remaining in the digestive tract contents of swine (both age groups) and suckling sheep was present in the ileum and large intestine, as much as one-third was still in the four-compartment stomach of weaned sheep 3 days after oral administration.

43714 Bioaccumulation, distribution, and dose of ^{241}Am, ^{244}Cm, and ^{238}Pu in developing fish embryos. Till, J.E.; Frank, M.L. (Oak Ridge National Lab., Tenn. (USA)). pp 645-648 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Vol. 2. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977).

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

The dose from several actinide elements to a sensitive stage in the development of one type of aquatic biota, the fish egg, was assessed. An investigation was made of the uptake and distribution of ^{241}Am, ^{244}Cm, and ^{238}Pu by developing embryos of fish. Eggs from mature carp, Cyprinos carpio, that had been spawned in the laboratory were placed in dishes containing ^{241}Am(III)- ^{244}Cm(III)-, or ^{238}Pu(IV)-citrate in solution at an activity concentration of approximately 10^{-3} μCi/ml. Samples of eggs were taken at seven intervals during the 72-hour period of embryogenesis. Egg contents were separated from the membrane prior to analysis to quantify the activity that penetrated the chorion. Autoradiographs of 16-μm thick egg sections confirmed that alpha radioactivity was present in the egg contents and permitted the distribution of activity to be determined. Concentration factors were calculated based on activity ratios for the egg contents (excluding the chorion) over the develop-

ment period. Maximum concentration factors occurred at hatching and were found to be 25, 40 and 3 for ^{241}Am, ^{244}Cm and ^{238}Pu, respectively. Collectively, these data were used to estimate the dose from americium, curium and plutonium in natural ecosystems to developing fish eggs which have embryological characteristics similar to carp.

PLANTS

REFER ALSO TO CITATION(S) 43595

THERMAL EFFECTS

INVERTEBRATES

43715 (PB—275251) Analysis of exposure panel data collected at Millstone Point, Connecticut. Final report. Brown, R.T.; Moore, S.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.; Resource Management Associates, Lafayette, Calif. (USA)). Jul 1977. 129p. (MIT/EL—77/015). NTIS PC A07/MF A01.

Exposure panels are small pine and transite boards submerged in water environments to monitor communities of boring and fouling organisms. Exposure panel data collected in the vicinity of the Millstone Nuclear Power Plant are analyzed to test hypotheses regarding ecological effects of power plant intake and discharge of cooling water; and to evaluate and re-design the existing monitoring program. Hypotheses of no difference in means and variance of the total number of species on panels between pre-operational and operational samples are accepted at a 5% significance level. Time series and multivariate analyses are also investigated. Power analysis demonstrates that the existing data are sufficient to detect changes of three species on a panel with 95% probability.

43716 Effect of temperature on reproduction of Cyclops vernalis Fischer (Copepoda, Cyclopoida). Hunt, G.W. (NUS Corp., Pittsburgh); Robertson, A. *Crustaceana (Leiden);* **32**: No. 2, 169-177(Mar 1977).

Temperature is undoubtedly one of the most important determinants of relative changes in seasonal abundance recorded for this species as shown by the seasonal changes recorded for this form by several authors. Leonard and Ponder (1949) found C. vernalis especially numerous in vernal and autumnal rain pools but found no adults in winter samples. Andrews (1953) found that in western Lake Erie this species was most abundant when the water temperature was about 20°C, with numbers decreasing above 23°C and below 10°C. Cummins et al. (1969) observed that the animals they studied reached their maximum density during the months of May and June. Coker (1934) and Aycock (1942) have carried out laboratory experiments to study the effects of temperature on the developmental rate of the immature stages of this copepod and Coker also studied the upper lethal temperature. The purpose of the experiments reported was to observe and compare the longevity, fecundity, egg development rate and egg viability for Cyclops vernalis at different temperatures. Such knowledge is valuable in understanding and predicting the effects of temperature changes in the natural habitat on the population dynamics of this cyclopoid species.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 43664

CELLS

REFER ALSO TO CITATION(S) 43638, 43645

43717 Production of chromosome aberrations in various mammalian cells by triethylenemelamine. Luippold, H.E.; Gooch, P.C.; Brewen, J.G. (Oak Ridge National Lab., TN). *Genetics;* **88**: No. 2, 317-326(Feb 1978).

The cytogenetic effects of triethylenemelamine (TEM) were studied using five different mammalian tissues. Treatments of 0.1 and 0.2 mg/kg TEM on differentiating mouse spermatogonia and bone marrow cells showed no significant differences in the frequency of chromosomal aberrations produced in these two tissues. At higher doses, however, the sensitivities of the two tissues appear to be different. The frequency of aberrations varies with time after treatment, with the greatest amount occurring at the later fixation times. Results of an experiment on primary spermatocytes indicated a correlation between the frequency of chromosome aberrations and DNA replication. Human peripheral leukocytes were utilized in an attempt to clarify the cell stage specificity of TEM-induced chromosome aberrations. Cultures were treated with TEM prior to PHA stimulation (G_0), as well as various time intervals after stimulation (late G_1, S, and G_2). The most sensitive stages of the cell cycle to aberration induction were later G_1 and S, with chromatid aberrations the predominant type. A very low yield of chromosome damage was observed with the G_0 and G_1 treated stages. The experiments described tend to support the view that TEM is most effective at inducing aberrations when an intervening round of DNA replication has occurred.

43718 Studies on the mechanisms of carcinogenesis by polycyclic aromatic hydrocarbons and their derivatives. Heidelberger, C. (Univ. of Wisconsin, Madison). pp 1-8 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

We can formulate two simple questions about the cellular mechanism of chemical carcinogenesis that can be critically answered in cell cultures, but not in whole animals. Do chemical carcinogens transform normal cells directly, or do they somehow select for preexisting malignant cells. We answered this question unequivocally through the discovery that single prostate cells cultured alone in a dish, could be transformed by MCA with high efficiency; this rules out selection. Do chemical carcinogens carry out the transformation by themselves, or do they "switch on" latent RNA tumor viruses. We found in C3H/10T1/2 cells that a number of clones independently transformed to malignancy by various chemicals lacked detectable oncornaviruses, their core gs antigens, or reverse transcriptase. Thus, we can say at least in these cells that chemicals, including PAH and their epoxides, can transform cells to malignancy without "switching on" infectious viruses of their cores. Whether or not viral-specific RNA is "switched on" during transformation is currently under investigation in our laboratories. I have concentrated in this chapter on the contributions of the recent cell culture systems toward elucidation of the mechanisms of action PAH. It is evident that these systems are also potentially useful as primary screens for environmental carcinogens, and much work is going on in this direction. We have stressed the necessity of doing metabolic, enzymatic, and structural studies in cells in which malignant transformation can be measured at the same time. This to us seems much more relevant than studies of metabolism of PAH in livers, to which they are not carcinogenic, and in cells that are not transformed by PAH.

MICROORGANISMS

REFER ALSO TO CITATION(S) 43638

INVERTEBRATES

REFER ALSO TO CITATION(S) 42258, 43600, 43604

43719 Uptake of hydrocarbons from marine sediments contaminated with Prudhoe Bay crude oil: influence of feeding type of test species and availability of polycyclic aromatic hydrocarbons. Roesijadi, G.; Anderson, J.W.; Blaylock, J.W. (Marine Research Lab., Sequim, WA). *J. Fish. Res. Board Can.;* **35**: No. 5, 608-614(May 1978).

Selected benthic animals were exposed to marine sediments contaminated with Prudhoe Bay crude oil, and uptake of hydrocarbons was monitored under various experimental schemes. When uptake of aliphatic and diaromatic hydrocarbons by two deposit feeders, Macoma inquinata and Phascolosoma agassizii, was compared with that of a suspension feeder, Protothaca staminea, we found that the deposit feeders generally accumulated hydrocarbons to a greater extent than the suspension feeder. However, other factors, such as the intrinsic capabilities of species to accumulate hydrocarbons, also played an important role in the extent of contamination. Hydrocarbon concentrations in the bivalve species (M. inquinata and P. staminea) increased during the 60-d exposure period; whereas concentrations in the sipunculid Phascolosoma agassizii appeared to have reached an equilibrium relatively early in the exposure. Experiments on uptake of ^{14}C-phenanthrene, -chrysene, -dimethylbenz[a]anthracene, and -benzo[a]pyrene by M. inquinata indicated that compounds directly associated with sediment were less available for uptake than those released from sediment to the surrounding seawater. Concentration factors for uptake from sediment were less than or equal to 0.2, while those for uptake from seawater were 10 to 1349. Additionally, the heavier molecular weight aromatic compounds tended to be more concentrated in tissue and retained for longer periods of time than the lighter compounds.

43720 Alterations in growth and physiology of soft-shell clams, Mya arenaria, chronically oiled with Bunker C from Chedabucto Bay, Nova Scotia, 1970—1976. Gilfillan, E.S.; Vandermeulen, J.H. (Bedford Inst. of Oceanography, Dartmouth, Nova Scotia). *J. Fish. Res. Board Can.;* **35**: No. 5, 630-636(May 1978).

Two populations of soft-shell clam, Mya arenaria, one from a chronically oiled lagoon (since the Arrow oil spill in 1970) and the

other from a nonoiled lagoon, were compared as to population structure, growth, and metabolism. The oiled lagoon sediments contained up to 3800 μg/g oil (uv determination), and clams up to 200 μg/g hydrocarbon in their tissues (fluorescence). The oiled population of clams differed from the nonoiled population in lower total numbers with fewer mature adults, a 1 to 2 yr lag in tissue growth, a lower shell growth rate, and a reduced carbon flux with a lower assimilation rate. Results are interpreted to indicate that the recovery potential of M. arenaria in these oiled sediments is low and that these oiled populations remain under continued stress 6 yr after the Arrow spill.

VERTEBRATES

REFER ALSO TO CITATION(S) 43635, 43640, 43641, 43642, 43643, 43644, 43646, 43647, 43648, 43650

43721 (NTISUB/D—150) **Tox-tips. Monthly report.** (National Library of Medicine, Washington, D.C. (USA)). 1978. 12 issuesp. National Library of Medicine, Washington, DC.

Toxicological study of inhaled shale materials in rats and monkeys; Carcinogenic potential of oil shale and its process derivatives in mice; Teratogenic potential of benzene in rats; Teratogenic potential of Stoddard solvent in rats; Teratogenic potential of toluene in rats; Teratogenic potential of xylene in rats; Behavioral and physiological effects of microwave exposure in rats; Behavioral effects of 2450 MHz microwave radiation in rats; Effects of 915 MHz microwave radiation in rats; Effects of 2450 MHz microwave radiation in rats; the effects of prenatal exposure to 915 MHz microwave radiation in rats; The effects of prenatal exposure to 2450 MHz microwave radiation in rats; Behavioral effects of 915 MHz microwave radiation in rats; Teratological study of 2450 MHz microwave exposure in mice; Teratogenic study of benzene in mice; Teratogenic study of toluene in mice; Teratogenic study of xylene in mice; Effects of microwaves on immune defense mechanisms in mice; Effects of microwave exposure on immune defense mechanisms in perinatal rats; Teratological study of mice exposed to microwaves; Index of compounds; Index of institutions and investigators.

43722 Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976). 462p. $35.00.

Polynuclear aromatic hydrocarbons are widespread contaminants of the environment, primarily occurring as a result of combustion and pyrolysis of organic materials. Concern over their prevalence stems from the evidence that a significant number are known to be carcinogenic. This volume surveys the chemistry of these compounds, including analytical procedures for environmental and biological samples as well as their metabolism, activation, and mechanism of carcinogenicity. Separate abstracts were prepared for the 31 papers included in the volume.

43723 Comparison of benzo[α]pyrene metabolism by primates, rats, and miniature swine. Leber, P.; Kerchner, G.; Freudenthal, R.I. (Battelle Columbus Labs., OH). pp 35-43 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The squirrel monkey liver metabolizes BP similarly to the rhesus, although quantitative differences are seen. Further improvements are hoped for in the metabolite identification area through the use of larger capacity columns, increased numbers and availability of synthesized metabolites, and a new HPLC-mass spectrometry combination. At present there exists a dearth of information of the carcinogenic potential of polycyclic hydrocarbons in the higher primates. The separation and identification of BP metabolites obtained from these animals, and the subsequent testing of these chemicals in vitro systems or rodents will perhaps circumvent the problem of using large numbers of primates for the evaluation of carcinogenicity.

43724 Lead in tissues of mallard ducks dosed with two types of lead shot. Finley, M.T. (Patuxent Wildlife Research Center, Laurel, MD); Dieter, M.P.; Locke, L.N. *Bull. Environ. Contam. Toxicol.;* **16**: No. 3, 261-269(1976).

Mallard ducks (Anas platyrhynchos) were sacrificed one month after ingesting one number 4 all-lead shot or one number 4 lead-iron shot. Livers, kidneys, blood, wingbones, and eggs were analyzed for lead by atomic absorption. Necropsy of sacrificed ducks failed to reveal any of the tissue lesions usually associated with lead poisoning in waterfowl. Lead levels in ducks given all-lead shot averaged about twice those in ducks given lead-iron shot, reflecting the amount of lead in the two types of shot. Lead in the blood of ducks dosed with all-lead shot averaged 0.64 ppM, and 0.28 ppM in ducks given lead-iron shot. Lead residues in livers and kidneys of females given all-lead shot were significantly higher than in males. In both dosed groups, lead levels in wingbones of females were about 10 times those in males, and were significantly correlated with the number of eggs laid after dosage. Lead levels in contents and shells of eggs laid by hens dosed with all-lead shot were about twice those in eggs laid by hens dosed with lead-iron shot. Eggshells were found to best reflect levels of lead in the blood. Our results indicate that mallards maintained on a balanced diet and dosed with one lead shot may not accumulate extremely high lead levels in the liver and kidney. However, extremely high lead deposition may result in the bone of laying hens after ingesting sublethal amounts of lead shot a result of mobilization of calcium from the bone during eggshell formation.

MAN

REFER ALSO TO CITATION(S) 43577, 43635, 43642, 43649, 43722

43725 (NTIS/PS—77/1181) **Environmental carcinogens. Volume 1. 1964-November, 1976 (a bibliography with abstracts). Report for 1964-Nov 76.** Crockett, P.W. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 192p. NTIS PC N01/MF N01.

The bibliography cites research reports on the identification, sources, and health effects of environmental carcinogens. Included are studies on pesticides, fire extinguishing agents, environmental pollutants, food additives, and radiation. (This updated bibliography contains 187 abstracts, none of which are new entries to the previous edition.)

43726 (NTIS/PS—77/1182) **Environmental carcinogens. Volume 2. November 1976—December 1977 (a bibliography with abstracts). Report for Nov 76—Dec 77.** Crockett, P.W. (National Technical Information Service, Springfield, Va. (USA)). Dec 1977. 119p. NTIS PC N01/MF N01.

The bibliography cites research reports on the identification, sources, and health effects of environmental carcinogens. Included are studies on pesticides, fire extinguishing agents, environmental pollutants, food additives, radiation, and other known or suspected carcinogenic substances. (This updated bibliography contains 114 abstracts, all of which are new entries to the previous edition.)

43727 (PB—273016) **Air pollution and health in Washington, D.C.: some acute health effects of air pollution in the Washington metropolitan area. Final extra-mural report, 1 January 1973—31 December 1974.** Seskin, E.P. (National Bureau of Economic Research, Inc., Washington, D.C. (USA)). Jul 1977. Contract EPA-68-01-3144. 97p. NTIS PC A05/MF A01.

The study has attempted to assess some of the acute health effects of air pollution. Specifically, the investigation has tested the hypothesis that air pollution can aggravate the health status of a population and can result in increased utilization of certain types of medical care services. The study period was 1973-1974 and centered in the Washington, D.C. Metropolitan Area. Statistical models were formulated, explaining health-care utilization of a group practice medical care plan. Primary interest was focused on the effects of mobile-source air pollutants including carbon monoxide, nitrogen dioxide, non-methane hydrocarbons, and photochemical oxidants. Meteorological conditions as well as other variables thought to influence the consumption of medical services were included in the models as explanatory variables. The statistical results indicated that air pollution levels had a very limited effect on the health-care utilization of the group practice.

43728 (PB—273233) **Geochemical environment as related to the distribution of cancer in Washington County, Maryland. Final report 1970—1976.** Cannon, H.L. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 34p. NTIS PC A03/MF A01.

The collection of house-to-house epidemiological information, supplemented by detailed data on the geology and soils of four election districts in Washington County, Maryland, showed that cancer occurred more frequently in houses located on Catoctin metabasalt, Martinsburg shale, and Rockdale Run formation and in houses located on clay loam soils rather than on silt loams. Soils from 'index' houses (those in which cancer cases had lived continuously for 20 years or more, or in which there had been more than one case) contained more Mg, P, Zn, Pb, and Be than soils from houses in which there had been no cancer experience, but differences could not be shown to be statistically significant. The higher median concentrations in vegetables from houses in which there had been no cancer were statistically significant for Cu, Ca, and Cr, and probably significant for Pb. The median distance of 'index' houses from a road was 65 feet; that of houses in which there had been no cancer was 300 feet. The pilot study seems to indicate that the following items may be causally related, either singly or in combination, to the occurrence of cancer: carcinogens associated with vehicular exhaust,

high nitrate concentrations in drinking water and in vegetables, and the absence of selenium in soils.

43729 (PB—274641) **Environmental factors and the development of disease and injury in the alimentary tract. Final report 1970-76.** Schedl, H.P. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd); Iowa Univ., Iowa City (USA). Coll. of Medicine). Dec 1976. 18p. NTIS PC A02/MF A01.

The review examines interactions between the alimentary tract and environmental agents. In these interactions the alimentary tract is considered as an integrated organ system extending from mouth to anus. The alimentary tract shares with the skin and its appendages and the respiratory system the distinction of being a portal of entry into the human body for environmental agents as well as a target for their action. Food and water-borne environmental agents enter the body via the alimentary tract. By injurying the alimentary tract, environmental agents alter their portal of entry and thereby modulate their effects on the organism. Such modulation may enhance or depress effects of these agents. Interactions between environmental factors and the alimentary tract depend on (1) factors related to the alimentary tract that are determined by anatomic, physiologic, and biochemical considerations; (2) factors related to the environmental agents; and (3) individually determined factors. The role of these factors in development of disease and injury is considered.

43730 (PB—275520) **Trace element abnormalities in chronic uremia. Final report 24 Jun 74—15 Jun 77.** Gonick, H.C.; Alexander, G.V. (California Univ., Los Angeles (USA). Dept. of Medicine). 28 Jul 1977. Contract N01-AM-6-2212. 124p. NTIS PC A06/MF A01.

The study assesses trace element alterations in non-dialyzed and dialyzed uremic patients. Trace element concentrations were measured in accessible peripheral tissues, namely red blood cells, plasma, urine and hair by both atomic absorption spectrophotometry and emission spectroscopy. Findings of note in the non-dialyzed uremics include elevated red blood cell and plasma levels of lead, tin, boron, silicon and arsenic, in particular the latter two trace elements. The pathophysiologic significance of these alterations is at present unknown. With dialysis, using water treated by reverse osmosis, trace element alterations tended to return toward normal with the exceptions of red blood cell arsenic, which remained elevated, and red blood cell and plasma silicon, which increased further. The persistently elevated arsenic levels were found to be due to contamination in the dialysate concentrate whereas the increased silicon levels were attributed to more protracted environmental exposure, rather than to the dialysis procedure.

43731 (UR—3490-1343) **Fetal methylmercury poisoning: new data on clinical and toxicological aspects.** Marsh, D.O.; Myers, G.J.; Clarkson, T.W.; Amin-Zaki, L.; Tikriti, S. (Rochester Univ., N.Y. (USA). School of Medicine and Dentistry; Baghdad Univ. (Iraq). Coll. of Medicine). 1977. Contract EY-76-C-02-3490. 6p. (CONF-770486—1). Dep. NTIS, PC A02/MF A01.

From Meeting of the American Neurological Association; Chicago, IL, USA (Apr 1977).

Feta! methylmercury (MeHg) poisoning causing severe brain damage has been reported previously but dose-response data for critical levels of MeHg have been inadequate. Following the consumption of MeHg contaminated bread in Iraq, hair samples were obtained from women who had been pregnant during MeHg exposure and consecutive segments of hair were analyzed to provide peak hair mercury concentrations. When last examined the children were aged 4½ to 5 years. Only 4 of the 29 children had severe neurological signs but mild spastic diplegia was observed. Ten mothers had peak hair mercury concentrations between 112 and 384 parts per million (ppM). Their children had the following abnormalities (percentages in parentheses refer to findings in the children of 15 mothers with peak hair mercury levels less than 25 ppM); early motor retardation 50%; delayed speech 70% (7%); mental retardation 40%; convulsive disorder 30%; extensor plantar 55%; neurological signs other than plantars 40%; small head 40%; short stature 70%. MeHg induced fetal brain damage with maternal hair mercury concentrations as low as 112 to 384 ppM has not been reported previously and indicates the particular susceptibility of the fetal brain.

43732 Long-term exposure to jet fuel. An investigation on occupationally exposed workers with special reference to the nervous system. Knave, B.; Persson, H.E.; Goldberg, M.; Westerholm, P. *Scand. J. Work, Environ. Health;* 2: No. 3, 152-164(Sep 1976).

Chronic solvent intoxication due to jet fuel vapor was diagnosed after tests on 29 aircraft factory workers. The exposed subjects were classified into (1) heavily exposed and (2) less heavily exposed groups. Tests included a clinical neurological examination, measurements of the peipheral nerve conduction velocities and threshold determination of vibratory sensations in the extremities. All 13 examined in the first group and 7 of 16 in the second group stated that, on repeated occasions, they had experienced acute effects (dizziness, dyspnoea, heart palpitations, chest striction, nausea, headaches) of the jet fuel vapors in the inhaled air. Air overrepresentation of symptoms of neurasthenia and physical disturbances, polyneuropathic symptoms and plyneuropathic findings were evident from the neurological status both in the heavily exposed group and in the two groups taken as a whole when comparison was made with reference groups. Moreover, relatively lower nerve conduction velocities and higher vibration thresholds were witnessed in both groups compared with a reference group from the heavy metal industry.

43733 Mechanisms of formation of polynuclear aromatic compounds in combustion systems. Crittenden, B.D. (Univ. of Bath, Eng.); Long, R. pp 209-223 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Whereas one can only speculate about the mechanism(s) of PAH formation from the nature of the stable hydrocarbons identified, such compounds bear a direct relationship to the free-radical species involved. In agreement with thermodynamic predictions the blue reaction zone results in dehydrogenation and decomposition of residual hydrocarbon species providing acetylenic radicals which, via chain lengthening and further dehydrogenation can account for the formation of the polyacetylenes. The straight or branched polymeric radical intermediates may be cyclization or ring closure also form apparently key aromatic intermediates such as phenylacetylene, styrene, and indene. The significant departure from the predicted thermodynamic equilibrium high above the burner surface for the reactions involving styrene and phenylacetylene indicates the probable importance of a C_6-C_2 hydrocarbon (radical) in the formation of higher molecular weight molecules, e.g., PAH. Although the results indicate that PAH are adsorbed onto soot particles upon sampling it has not been possible to determine whether the PAH act as important precursors of soot since as soot formation increases the concentrations of both the polyacetylenes and the PAH decrease simultaneously.

43734 Formation of polynuclear aromatic hydrocarbons from combustion of organic matter. Schmeltz, I.; Hoffmann, D. (American Health Foundation, Valhalla, NY). pp 225-239 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

We have discussed various aspects of PAH formation, using thermal processes occurring in a burning cigarette as a base, and the role played by tobacco-specific terpenoids as preferential PAH precursors. As a result of studies in PAH formation, several approaches to the reduction of PAH in tobacco smoke have been proposed based on selective removal of PAH precursors, influencing thermal processes, and inhibiting the generation of PAH by the use of free-radical scavengers. Various other pathways to PAH have been explored in model pyrolysis studies. These are multifaceted, and involve different reactive species. Furthermore, it is obvious that PAH are formed as a by-product of limited combustion, and as such are generated in relatively small amounts. This appears to be the case in the combustion of tobacco, gasoline, and most other incomplete combustions which pollute our respiratory environment.

43735 Improved measurement techniques for polycyclic aromatic hydrocarbons from combustion effluents. Strup, P.E.; Giammar, R.D.; Stanford, T.B.; Jones, P.W. (Battelle Columbus Labs., OH). pp 241-251 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The Adsorbent Sampler provides an extremely simple sampling technique from the standpoint of operation and sample recovery when compared to EPA Method 5. Not only is the Adsorbent Sampler at least twice as efficient as the EPA Method 5 train in collecting PAH, but utilization of the Adsorbent Sampler can reduce sample-recovery time as much as 50%. In addition, when burning higher sulfur fuels, the performance of the Adsorbent Sampler is far superior to that of the Method 5 train, especially when operating a combustion system at a relatively high particulate loading. The value of the integral heat exchanger should not be overlooked. In addition to permitting use of the Adsorbent Sampler for a wide range of stack gas temperatures, condensation of water vapor may be obviated by operating the sampler at about 10°F or more above the dew point. In future studies we propose to carry out a detailed study of the fate of sulfur dioxides in the sampler. Additionally, validation for a wide range of organic species other than PAH will be carried out, in addition to a more detailed evaluation of optimum sampling temperatures. It is strongly recommended that future PAH sampling should be carried out by sampling systems to the Battelle-developed Adsorbent Sampler; its comparison with Method 5 throws serious doubts upon earlier data which were obtained by the latter method.

43736 Isolation, identification, and quantitation of the polynuclear aromatic hydrocarbons in tobacco smoke. Severson, R.F.; Snook, M.E.; Higman, H.C.; Chortyk, O.T.; Akin, F.J. (Dept. of Agriculture, Athens, GA). pp 253-270 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

A neutral fraction of cigarette smoke condensate, which had shown biological activity and was known to contain polynuclear aromatic hydrocarbons (PAH), was fractionated by gel filtration chromatography. The resulting gel fractions were subjected to gas chromatographic separation and their components were identified by relative GC retention times, uv spectra, and mass spectral data. More than 500 PAH, ranging from indene to the dimethylcoronene, were characterized. This method of isolation has yielded fractions which were more amenable to definitive identifications. The isolation and identification work led to the development of a procedure for analyzing the PAH content of the CSC from 100 or less cigarettes. This method now allows the comparison of various cigarettes on the basis of their smoke PAH levels in a manner similar to the established tar and nicotine analysis.

43737 Human exposure to polynuclear aromatic hydrocarbons. Bridbord, K. (National Inst. for Occupational Safety and Health, Rockville, MD); Finklea, J.F.; Wagoner, J.K.; Moran, J.B.; Caplan, P. pp 319-324 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

Polynuclear aromatic hydrocarbons (PAH) are formed in combustion processes involving fossil fuels, or more broadly, from compounds containing carbon and hydrogen. The emissions of PAH from motor vehicles have been well documented. Benzo[a]pyrene (BaP) constitutes about 3 to 5% of the emitted, identified PAH from motor vehicles. The area-wide contribution of PAH from motor vehicles is thought, however, to be a small percentage (about 1%) of the total ambient loading. Localized exposures to motor vehicle exhaust may, however, increase this component. Principal sources of ambient PAH are heat and power generation, refuse burning, and coke production. It should be stressed that present crude emissions inventories for PAH may contain significant errors. In addition to polynuclear compounds in ambient air, exposure also occurs from sources of PAH in the indoor environment including industrial contamination and cigarette smoking. Cigarettes, in general, represent the most important overall source of exposure among smokers. Sidestream cigarette smoke may, however, result in high exposures for nonsmokers in the indoor environment. This paper examines the localized concentrations of PAH and estimates exposure levels which people encounter from various sources. These estimates are then compared to levels of exposure experienced by cigarette smokers, using BaP as an index compound. In this regard, it is recognized that to the extent that polynuclear aromatic compounds besides BaP are also present, BaP represents a poor surrogate for this purpose. Unfortunately, better data are generally not available.

43738 Quantitative distribution of polynuclear aromatic hydrocarbons in relation to particle size of urban particulates. Katz, M.; Pierce, R.C. (York Univ., Toronto, Ont.). pp 413-429 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

PAH, because they are believed to be associated primarily with the particulate matter suspended in the atmosphere, have been traditionally collected using filtration techniques. Basically, the procedure involved drawing a specific volume of particulate-laden air through a porous filter of high collection efficiency at a regulated flow rate for a certain time interval. However, it is important to realize that the total weight of particulate matter collected represents a cumulative total of the fractional contributions of all particle sizes comprising the heterogeneous, polydisperse aerosol that is present in the atmosphere. Because the content of PAH and other suspected carcinogens have been determined almost exclusively on the basis of separation and analysis of organic material obtained from the above type of sampling system, no assessment of the PAH-content of the polluted atmosphere with respect to size of particles in an aerosol can be made. As a result of this inadequacy, size-fractionated particulate matter was collected at several locations in Toronto, Ontario and, subsequent to gravimetric analysis, approximately 20 PAH were identified and quantitatively determined. In the following parts of this paper, the authors present evidence that PAH are associated primarily with small, lung-depositing particles. In addition, the size-mass distribution of PAH-containing particulates is examined with respect to season of sampling and proximity to specific emission sources.

43739 Clinical problems induced by PAH. Stemmer, K.L. (Univ. of Cincinnati). pp 431-433 of Carcinogenesis: a comprehensive survey. Volume I. Polynuclear aromatic hydrocarbons: chemistry, metabolism, and carcinogenesis. Freudenthal, R.; Jones, P.W. (eds.). New York; Raven Press (1976).

The difficulty of relating skin cancer, pulmonary carcinomas, and other diseases to occupational exposure to polycyclic aromatic hydrocarbons is emphasized. Carcinogenic effects of increased use of coal and shale oil, cigarette smoking, and smoke from plastics are considered. The role of polycyclic hydrocarbons in emphysema and cardiovascular diseases is pointed out. (HLW)

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 43587

43740 (AD-A—047365) **Biological aspects of terrestrial oil spills: USA CRREL oil research in Alaska, 1970—1974. Final report 1970—1974.** Deneke, F.J.; McCown, B.H.; Coyne, P.I.; Rickard, W.; Brown, J. (Cold Regions Research and Engineering Lab., Hanover, N.H. (USA)). Dec 1975. 75p. (CRREL-RR—346). NTIS PC A04/MF A01.

Knowledge concerning the biological effects of oil pollution on arctic and subarctic terrestrial ecosystems is limited. USA CRREL research personnel conducted investigations from 1970 through 1974 to expand information in this field. Objectives were to: (1) define the ecosystems most sensitive to the presence of crude oil or its refined products, (2) quantify and understand the injury response, and (3) establish time frames for manifestation of damage and natural restorative processes in arctic and subarctic regions. This was accomplished through: (1) surveys of natural oil seepages and past accidential spills in the Arctic and Subarctic, (2) initiation of controlled oil spills and (3) detailed laboratory investigations. Results demonstrated that terrestrial oil spills will to some degree be detrimental to both artic and subarctic plant communities. Degree and longevity of damage will be influenced primarily by the magnitude of the spill, season of occurrence and existing soil moisture content. Rapid recovery of plant communities subjected to spills will occur only if root systems remain relatively unaffected. Damage will be more extensive and long-term when root systems are saturated witl oil. Effects of damage will be manifested gradually over several seasons being influenced by winter stresses. Variation does exist in plant species susceptibility. Carex aquatilis a predominant sedge of the arctic is markedly resistant to crude oil damage. In the taiga Picea mariana is very susceptible. Plant recovery can be enhanced through the application of fertilizer. Fertilization, in addition to its direct effect on plant nutrition, will stimulate microbial decomposition of crude oil. (Author)

43741 (AD-A—047606) **Laser hazards bibliography. August 1977. Eighth edition.** Sliney, D.H.; Krial, N.; Forbes, C. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md. (USA)). Aug 1977. 141p. NTIS PC A07/MF A01.

The Laser Hazards Bibliography consists of 1,838 references in the open literature broken into subject categories which relate to general biological effects, the eye, the skin, laser safety, laser propagation in the atmosphere, and laser measurements. (Author)

43742 (AD-A—047647) **Biological effects of nonionizing electromagnetic radiation. Volume II. Number 2, December 1977. Quarterly report Sep—Dec 77.** Kleinstein, B.H.; Saboe, E.P. (Franklin Inst. Research Labs., Philadelphia, Pa. (USA)). Dec 1977. Contract TP-7AC024. 55p. (FIRL-C—4735-01). NTIS PC A04/MF A01.

This quarterly digest presents current awareness information on the biological effects of nonionizing electromagnetic radiation (microwave and radiofrequency) in the range of o Hz to 100 GHz. The effects of magnetic and electric fields (static and alternating) are also covered. Each issue contains abstracts of English and foreign current literature, summaries of ongoing research investigations, news items, and a directory of meetings and conferences. (Author)

43743 (AD-A—048060) **Microwave magic. Conference report.** Bateman, J.B. (Office of Naval Research (USA). London Branch Office). 17 Nov 1977. 29p. (ONRL-C—14-77). NTIS PC A03/MF A01.

This is a report, with critical comment, of a meeting convened by a microwave research department within the French National Research Center for Space and Aeronautics in order to present the results of current French research on the biological effects of microwaves. The report proper is preceded by notes on the sponsoring organizations and by critical remarks on a series of papers describing the remarkable biological properties of the physically uncharacterized radiation emitted by an apparatus assembled by the inventor A. Priore. The topics discussed ranged from specific effects of microwave on microorganisms and on the vertebrate central nervous system, to discussions of microwave thermography and microwave heating in the diagnosis and treatment of cancer.

The empirical approaches generally used deflected attention from any thorough-going attention to the vexed question of thermal versus non-thermal effects, although a useful distinction was drawn between the conditions under which non-thermal effects might be detectable and those under which such effects would be obscured by temperature changes.

43744 (PB—272839) **Procedures for field testing microwave ovens. Final report.** (Bureau of Radiological Health, Rockville, Md. (USA)). Aug 1977. 45p. (FDA/BRH—77/160; DHEW/PUB/FDA—77/8037). NTIS PC A03/MF A01.

The manual sets forth guidance and procedures for field testing microwave ovens for compliance with the microwave emission and safety interlock operation requirements of the Federal radiation safety performance standard. It presents background material and complete instructions for carrying out the necessary tests and also describes procedures for completing form FD 2536, 'Microwave Oven Field Test Record,' which is used to report the data to the Bureau of Radiological Health. It has been prepared to provide a detailed reference document that will be particularly useful to FDA, State, and local radiation control personnel responsible for the field testing of microwave ovens.

43745 (PB—273232) **Research needs for establishing an environmental microwave radiation safety standard. Final report 1970—1976.** Elder, J.A. (New York Univ., N.Y. (USA). Task Force for Research Planning in Environmental Health Sciences (2nd)). Dec 1976. 15p. NTIS PC A02/MF A01.

Since World War II, a new environmental problem has been created by the electromagnetic emissions from microwave frequency generators used for communications, radio-navigation, military applications, diathermy, food ovens, and other industrial purposes. Past research has established the thermal hazard of such emissions, particularly on temperature-sensitive systems such as the avascular eye lens and the male gonads. On this basis, ANSI in 1966 recommended a safety level of 10 mW/sq. cm for both pulsed and continuous wave radiation in the frequency range from 10 MHz to 100 GHz for periods greater than 0.1 hour. This guide was subsequently adopted by Occupational Safety and Health Administration (OSHA). There are no specific exposure recommendations, however, for the general population. Research to resolve these problems includes: Epidemiologic and clinical investigations of microwave effects on man both at high and lower power densities; chronic low-level studies of animals exposed to power densities; determination of the basic mechanisms of radio frequency effects on molecular and cellular components and the loci interaction as a function of power density; surveys to systematically evaluate the frequencies and intensities of electromagnetic radiation in the environment; and studies to relate the biological effects of microwaves to quantitative measurements of absorbed power.

43746 (PB—274218) **Measurement of rf power-absorption in biological specimens (10 to 100 mhz).** Greene, F.M. (National Bureau of Standards, Boulder, Colo. (USA)). Feb 1977. 31p. NTIS PC A03/MF A01.

A method is described for accurately determining the radio frequency (rf) power being absorbed by a biological specimen during nonionizing radiation exposure testing using the National Bureau of Standards RF Near-Field Synthesizer in the frequency range 10 to 100 megahertz. This method is based solely on measuring the forward and reflected power on the transmission line feeding the synthesizer. Commercially available rf wattmeters can be used, and an automatic data-acquisition system employed, if desired, to 'read' the meters and rapidly calculate, display, and record the rf power flow. The method has the advantage that the exact measuring point on the feed line is not critical, as it is with methods employing direct impedance measurements, and that the required measurements can be made without interfering with the exposure tests.

HEALTH AND SAFETY

43747 (PB—274716) **Occupational safety and health symposia, 1976.** (National Inst. for Occupational Safety and Health, Cincinnati, Ohio (USA); American Medical Association, Chicago, Ill.). Jul 1977. 164p. (DHEW/PUB/NIOSH—77/179). NTIS PC A08/MF A01.

The third volume of the Occupational Safety and Health Symposia is a continuing product of cooperation between NIOSH and the American Medical Association aimed at developing information to assist private practitioners with part-time occupational medicine responsibilities. The volume consists of papers presented at the NIOSH co-sponsored 36th AMA Congress on Occupational Health Conducted at Rochester, N.Y. in September 1976, and is published by NIOSH. The Symposium topics were medical roles in worker's compensation; what every physician should know about radiation; medical recordkeeping and surveillance; interdisciplinary teamwork in the health/safety professions; medical relationships with unions and management; when workers fly; how to do a walk-through survey; and women at work.

43748 (PB—274731) **Shakeout, cleaning, grinding, and inspection departments: health hazards in a foundry.** (National Inst. for Occupational Safety and Health, Cincinnati, Ohio (USA). Div. of Technical Services). Dec 1976. 35p. (DHEW/PUB/NIOSH—77/104). NTIS PC A03/MF A01.

The health hazards found in the shakeout, cleaning and grinding, and inspection departments of foundries are listed in order of importance for each area. They include dusts, metal fumes, noise, gases and vapors, solvents and ionizing and non-ionizing radiation. Each hazard is described and identified, and information given on how exposures may be reduced. The worker's responsibility for using good work practices and having medical examinations are explained. A list of do's and don'ts for a healthy work environment and some brief first aid information are given.

43749 (PB—274749) **RF radiation absorption patterns: human and animal modeling data.** Guy, A.W.; Webb, M.D.; McDougall, J.A. (Washington Univ., Seattle (USA). Bioelectromagnetics Research Lab.). Sep 1977. 79p. NTIS PC A05/MF A01.

Research performed to obtain the radiofrequency-induced power absorption patterns in models of humans and animal and to extrapolate the results to humans is described. Various models of animals and humans were exposed to radiofrequency fields and power absorption patterns and the rates of power absorption at specific anatomical locations within the models were thermographically recorded under simulated industrial exposure conditions. The results of the modeling research demonstrate the validity of this technique for predicting the magnitude and distribution of radiofrequency power absorption in humans and animals. The utility of the technique for extrapolation to human radiofrequency exposure thresholds from animal data was firmly established.

43750 **Interpretation and application of OSHA carcinogen standards for laboratory operations.** Rappaport, S.M.; Campbell, E.E. (Los Alamos Scientific Lab., NM). *Am. Ind. Hyg. Assoc. J.;* **37**: No. 12, 690-696(Mar 1978).

A safety protocol implemented at the Los Alamos Scientific Laboratory for a project involving 14 chemical carcinogens is described. Specific topics pertaining to facilities, personnel practice, laboratory operations, decontamination, and disposal are discussed within the context of regulations issued by the Occupational Safety and Health Administration.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 42357, 43607

43751 **Origin of abnormal formation pressures in central North Sea lower tertiary clastics.** Carstens, H. (Saga Petroleum, Oslo). *Log Anal.;* **19**: No. 2, 24-30(1978).

The existence of definite seals bounding an abnormally pressured formation in Central North Sea Lower Tertiary argillaceous sediments is questioned. The hypothesis submitted favors a self-sealing mechanism, provided by four major factors: high clay content, dominance of swelling clays, discontinuous limestone stringers, and gas.

43752 **Rifting and subsidence on passive continental margins in the north east Atlantic.** Montadert, L. (Institut Francais du Petrole, Rueil Malmaison, France); Roberts, D.G.; Auffret, G.A. *Nature (London);* **268**: No. 5618, 305-320(28 Jul 1977).

Deep-sea drilling in the Bay of Biscay and the Rockall Plateau show that passive continental margins are characterized by the absence of seismicity and include continental shelf, continental slope and continental rise physiographic provinces, exemplified by the borders of the Atlantic Ocean.

43753 **Field geologists' manual.** Berkman, D.A.; Ryall, W.R. (eds.). Parkville, Victoria, Australia; Australasian Institute of Mining and Metallurgy (1976). 306p. $16.00.

This manual is intended to provide a broad selection of basic material which may be required by a geologist during the course of his work. Those critical parts of a reference library that may be of use during short term field projects are abstracted. Chapter titles include: ethics and reporting; mineral and rock information; geochemistry; mining and economic geology; geological mapping; geometric and surveying data; engineering geology; geohydrology; geo-

physics; drilling; miscellaneous; and mathematical tables and conversion factors.

43754 (UCRL-Trans—11357) **Deep structure of the Earth's crust in southeastern Central Kazakhstan.** Moiseenko, F.S.; Pavlov, Yu.A. Translated from *Geol. Geofiz.;* No. 4, 47-52(1964). 38p. Dep. NTIS, PC A03/MF A01.

Data on the structure of the earth's crust in the southeastern part of Central Kazakhstan are presented. The data were obtained by comprehensive interpretation of geological and geophysical materials. The thicknesses and surface relief of the sedimentary-volcanogenous (A_1), granitic (A_2), dioritic (A_3), and basaltic (A_4) layers and the surface relief of the subcrustal layer (B_1) are considered. Sharp variability of the majority of layers with respect to thickness, the presence of deep submersion (8 to 10 km) inn the basaltic layer, and the absence of significant irregularities in the surface of the subcrustal layer are revealed. Further, the question of the correlation between crustal anomalies and structures and the correlation of the layers with each other is discussed.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 42301, 42568

43755 (KBS-TR—17) **Gravity field in Fennoscandia and postglacial crustal movements.** Bjerhammar, A. (Kaernbraenslesaekerhet, Stockholm (Sweden)). 1977. 98p. Dep. NTIS (US Sales Only), PC A05/MF A01.

The present study is devoted to the problems associated with disposal of radioactive waste in the Swedish crust. Recent investigations seem to indicate that the present uplift in Fennoscandia is no longer of isostatic origin. A tectonic factor has been detected and this component is supposed to dominate the uplift now recorded. The total uplift of the Swedish east-coast is ,.4-12 mm per year from south to north. The main object has been to discriminate between tectonic and isostatic movements. There has been practically no proof for the existence of a major tectonic movement in the Fennoscandian crust. The tectonic uplift is estimated to be below 1 mm per year. The problem of the optimated choice of a site for waste disposal inside the Swedish crust is very intricate and must be considered from a number of different points of view.

43756 (KBS-TR—18) **Movements and instability in the Swedish bedrock.** Moerner, N.A. (Kaernbraenslesaekerhet, Stockholm (Sweden)). 1977. 44p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The report gives a geological evaluation of the Swedish bedrock and its movements during the last 20,000 years, which may serve as a base for further evaluations of the possibilities of storing nuclear waste in the bedrock. The Swedish bedrock is by no means stable. Like all other bedrocks it is unstable. The Swedish bedrock has an old and rich tectono-geodynamic inheritance. Irregularities in the uplift in the form of shoreline bends and isobase irregularities have been established with ancient shorelines and geodetic data. They are in general all related to major faultlines and bedrock seams. Bouldery end moraines and bouldery ground in general register paleopseismic activity -(these areas must hence be excluded as alternatives for storage of nuclear waste in the bedrock). The next ice age, is either on its way or it will, under the most favorable circumstances, have begun 20,000 years from now (AP). At the next ice age, all the seismic and neotectonic effects from the deglaciation period will be repeated. During an ice age nuclear waste cannot be stored in the bedrock. If one succeed in finding a Precambrain bedrock unit within an area of smooth uplift, absence of recent earthquakes, the bedrock surface of which shows few fractures and no fault lines, and where the surroundings exhibit normal moraine features and normal till composition, this area must still be evaluated with respect to that which will happen and may happen in connection with the next ice age and in connection with the cyclic gravitational changes in the present linear uplift.

43757 (KBS-TR—19) **Studies on neotectonic activity in central and northern Sweden. Investigation of air-photos and interpretation of recent faults.** Laegerbaeck, R.; Henkel, H. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Sep 1977. 34p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Several fault-lines of presumed late-glacial age in northern Sweden are described. The faults have been identified and investigated mainly by means of air-photo interpretation. Morphologically the fault scarps are very conspicious and can be traced over long distances. The faults are all developed in the Precambrian. The amount of displacement on the dislocations is of the order of up to about 30 meters and the most extensive fault-line is about 150 km long. The syncronism between the deglaciation of the region and the fracturing offers a natural explanation of the phenomena. The direct reason for the close connection between deglaciation and tectonic movements may have been that the deglaciation proceeded rapidly. The regional connection between the neotectonic structures and the recent seismic pattern within the area is obvious. This indicates that the forces which produced the faulting are still active. Nevertheless it is evident that the faulting was more active in late-glacial times than today.

43758 (KBS-TR—25) **Coastal gneiss in Blekinge, geology and hydrogeology.** Larsson, I.; Wiklander, U.; Lundgren, T. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Aug 1977. 48p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The present work deals with the geology and the tectonics of the Precambrian of Blekinge in the southeastern Sweden. After comprehensive field studies of the tectonics of western Blekinge a tectonic-morphologic map was constructed. Statistical investigations concerning preferred orientation of fractures of the area was carried out.

43759 (SAND—77-1364) **SLA cap models and the CAPMOD code.** Lauson, H.S.; Byers, R.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

Interest in the computer simulation of the response of geological materials to shock waves has led to the development of many mathematical models of their behavior. One of the latest developments has been the elastic-nonideally plastic cap models which combine ideal plasticity, strain-hardening effects, and use of the associated flow rule. Investigation of these models has led to the development of CAPMOD, a highly interactive time-sharing computer program which calculates stress-controlled material response under conditions of proportional loading, triaxial loading, and uniaxial strain. The cap models and their implementation in CAPMOD are described and instructions for the use of the CAPMOD program are given.

43760 **Washington continental slope: quaternary tectonics and sedimentation.** Barnard, W.D. (Univ. of Washington, Seattle). *Mar. Geol.;* **27**: No. 1/2, 79-114(May 1978).

An analysis of the tectonics and sedimentation of the lower continental slope off the Washington coast indicates that although deformation has been relatively continuous throughout the Pleistocene, present rates of compression may be much less than the 2.3-cm/year rate derived from apparent plate motions. Over the last 0.5 m.y.B.P. or since the formation of the late Pleistocene discontinuity in Cascadia Basin, folding and thrusting of the outermost or marginal ridge of the lower slope have accommodated an average compression rate of about 0.7 cm/year. These anticlinal ridges have subsequently controlled sediment dispersal patterns and trapped both hemipelagic and turbidite sediments, which have accumulated during the Pleistocene at rates of less than 0.5 to more than 1 m/1000 years. A comparison of the sediment volume within the borderland basins and on Nitinat Fan indicates that at least 2/3 of the sediment originating from the upper slope canyons during the Pleistocene has bypassed the Washington slope and has been deposited in Cascadia Basin. During the last glacial period the borderland was apparently deluged with turbidity currents en route to the deep-sea fans of Cascadia Basin. With the onset of postglacial conditions about 10,500 B.P., turbidity currents occurred less frequently, contained finer-grained material, and tended to be depositional. Over the last 5000 years all of the major canyons have been filling with hemipelagic mud and sand/silt turbidites except for Quinault Canyon which flushes about every 500 years.

43761 **Instances of premonitory crustal velocity ratio changes in Iran.** Hedayati, A.; Brander, J.L.; Mason, R.G. (Imperial Coll., London). *Tectonophysics;* **44**: No. 1-4, T1-T6(10 Jan 1978).

Anomalous compressional to shear wave velocity ratios seem to have occurred shortly before microearthquakes recorded during a survey of the region of Teheran, Iran. Furthermore, the time durations of these changes have the same dependence on the subsequent magnitude as similar changes found elsewhere in the world.

43762 **Thought on heat flow and tidal drag as possible driving forces of plate tectonics.** Kilty, K.T. *Tectonophysics;* **44**: No. 1-4, T27-T28(10 Jan 1978).

The amount of useful work that can be extracted from the Earth's heat flow is examined from a thermodynamic standpoint and compared with that of tidal drag.

43763 **Instrumentation for observation of induced seismicity.** Kanasewich, E.R. (Univ. of Alberta, Edmonton, Can.). *Eng. Geol. (Amsterdam);* **11**: No. 2, 139-147(Jun 1977).

Instrumentation for observations of seismicity and ground acceleration near artificial reservoirs is evolving rapidly at the present time. Data recorded between 1936 and 1970, generally with

only 1 to 3 seismograph stations, has established that the impounding of a 'arge reservoir may lead to increased seismicity. Occasionally, shallow earthquakes in excess of magnitude 6 have occurred with resulting damage to surface structures and loss of life. Conditions leading to severe earthquakes have not been established but the pattern of enhanced seismicity as the reservoir level rises indicates that it is possible to predict when a dangerous level of earthquake rise is approaching. Increased use is now being made of larger arrays of detectors together with telemetry, storage of data on magnetic tape and even digital recording in the field. Future developments include complete digital recording of a broad range of instrumentation and detection and control of sampling rates by on-line microcomputers. As our instrumental sophistication increases and the relevant parameters for precursor activity are established it would appear that earthquake prediction near reservoirs is a possibility.

43764 (UCRL-Trans—11362) **Results of a study of the structure of the crystalline part of the Earth's crust in certain regions of the South-East of the Russian platform.** Pomerantseva, I.V. Translated from *Prikl. Geofiz.;* No. 31, 11-54(1961). 68p. Dep. NTIS, MF A01.

Portions of document are illegible.

Results of seismic work on the crust structure, carried out in 1958 along one of the reference regional profiles (VII) in the southeast of the Russian platform are presented. In the testing of the method of mapping the surface of the crystalline basement by waves whose kinematic characteristics are similar to those of head waves in regions with essentially different seismogeological conditions, the effectiveness of the method has been confirmed. The structure of the southeastern edge of the Russian platform along profile VII is given and the character of the transition of this platform into Prikaspiiskaya depression is clarified. The tectonic character of the relief of the crystalline basement is confirmed. Analysis of the character of distortions of the seismic sections, mainly in form, due to an incorrect interpretation of the waves' nature, suggests that a number of rises and depressions in the deep boundaries, with amplitudes of up to 10 km, that have been identified in the past are associated with this factor. In view of this the schemes of crust stucture constructed up to 1958 on the basis of DSS results correspond to real deep tectonics only in the first approximation. Consequently, the analysis of the nature of a number of gravitational and magnetic anomalies in various regions, based on the results of previous DSS work, cannot be regarded as sufficiently reliable and substantiated.

43765 (UCRL-Trans—11360) **Results of deep seismic sounding of the crust in one of the mountain regions of Central Asia.** Weizmann, P.S.; Gruzinskaya, B. Translated from *Stud. Geophys. Geod.;* **2**: No. 3, 213-230(1958). 34p. Dep. NTIS, MF/A01.

Portions of document are illegible.

Results of seismic surveys in northern Tien-Shan are reported. Deep seismic sounding of the crust, based on correlational tracing of seismic waves and wave groups, allows a systematic study of the main features of the deep structure of the crust and the detection and plotting of deep faults. Detailed structural study of the crust in seismically active regions and the combined interpretation with the results of seismicity studies and studies on the distribution of weak, local earthquake foci should prove of considerable value for seismic zoning and for the delineation of the seismically most active regions of the crust. It is demonstrated that the part of the regional gravitational anomalies that owe their origin to the combined influence of deep-seated masses of the basalt layer and the upper part of the mantle can be separated. Exclusion of this part of the anomaly will make it possible to identify local anomalies, which is important in searches for mineral deposits. The desirability of studying the structure of the crust by a combination of DSS and gravimetry, using the crust sections obtained by DSS as a reference, is demonstrated.

VOLCANOLOGY

REFER ALSO TO CITATION(S) 42565

43766 Columbia/Snake River: Yellowstone magmatism in the context of western U.S.A. cenozoic geodynamics. Thompson, R.N. (Imperial Coll. of Science and Technology, London). *Tectonophysics;* **39**: No. 4, 621-636(11 May 1977).

An attempt was made to calculate the total volume of Middle Cenozoic to Recent igneous rocks in the Columbia--Snake River--Yellowstone region by adding geophysically-derived estimates of the amounts of mafic intrusion to published data on the volumes of volcanic rocks. Recently published radiometric ages allow comparison of rates of basaltic magmatism in these ensialic provinces with those along equivalent lengths of mid-oceanic ridge. The rates of total magmatic activity (extrusive and intrusive) during the genesis of the Columbia River Plateau, Western Snake River Plain and Eastern Snake River Plain--Yellowstone sub-provinces were equivalent to those of mid-oceanic ridges with spreading half-rates of 10, 3 and 0.3 cm per year, respectively. It is shown that the hypothesis that magmatism in this region is the product of a deep-mantle convective plume, situated at present beneath Yellowstone, does not explain adequately several features of the Snake River Plain and becomes untenable when applied to the province as a whole. It is proposed instead that all major post-Eocene tectonic and magmatic features of the western U.S.A., east of the Sierra Nevada and Cascades, are products of comparatively shallow-rooted diapiric upwelling in the mantle; triggered at about 40 m.y. by extraction of mafic silicate melt and volatiles from the Farallon lithospheric plate, subducted at a comparatively low angle beneath the North American plate. Constriction of the Columbia River Plateau diapir by the subduction zone to its west led to "run away" mantle fusion and massive production of basic magmas.

43767 Volcanoes of the Earth. Bullard, F.M. Austin, TX; University of Texas Press (1976). 593p. $26.95.

Current knowledge of volcanoes and their effect on the environment and the people of the earth is presented. The book is based on actual field studies around the world. Discussion is presented in three sections entitled: facts and fiction about volcanoes; types of volcanic eruptions; and theory, cycles, utilization, and environmental effects of volcanoes. A chapter in the third section is devoted to man's use of geothermal energy. Two appendices, a glossary, bibliography, and index are included. (JGB)

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 42229, 43776, 43777

43768 (UCRL—52311) **Surface methods for determining the electrical conductivity of core samples.** Lytle, R.J.; Duba, A.E.; Willows, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1977. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

An electrode configuration is described for measuring the electrical conductivity of a core sample that does not require access to the ends of the sample. The methods can be made relatively insensitive to the shape of the sample, eliminating the need for machining. Validation of the measurement technique is provided by comparing results obtained from this method with actual measurements perpendicular and parallel to the core axis on granite samples. The seed idea for a new data inversion method is discussed, which could provide a three-dimensional picture of the low frequency conductivity profile throughout a sample (i.e., an impedance camera).

43769 Computation of master curves for electrical sounding with the sampling functions. Baranov, W. *Geophys. Prospect.;* **24**: No. 2, 222-232(Jun 1976). (In French).

An attempt to compute the master curves for the electrical vertical sounding with the aid of sampling functions was made. This was previously done with gravity and magnetic anomalies.

43770 Progress in the direct interpretation of resistivity soundings: an algorithm. Koefoed, O. (Technological Univ., Delft, Netherlands). *Geophys. Prospect.;* **24**: No. 2, 233-240(Jun 1976).

An algorithm is presented for the direct interpretation of resistivity sounding data. The algorithm is based on the method of successive reductions to lower boundary plane of the resistivity transform function. A novel aspect of the algorithm is that error limits are assigned to the initial values of the resistivity transform, and these error limits are carried through in all the subsequent computations. The width of the error range is then used as the basis for assigning weight factors in the final computation of thicknesses and resistivities of the layers. The errors in the resistivity transform derived from the solution given by the algorithm are usually not more than twice as large as those in the original data.

43771 Quantitative analysis of frequency-domain induced polarization soundings over horizontal beds. Patella, D.; Schiavone, D. (Univ., Bari, Italy). *Geophys. Prospect.;* **24**: No. 2, 334-343(Jun 1976).

From 37. meeting of the European Association of Exploration Geophysicists; Bergen, Germany (Jun 1975).

Following up a recent study of an indirect procedure for the practical determination of the maximum frequency-effect, defined as fe = I - rho/sub infinity//rho/sub dc/ with rho/sub infinity/ the resistivity at infinite frequency, it is shown at first how, through the Laplace transform theory, rho/sub infinity/ can be related to stationary field vectors in the simple form of Ohm's law. Then applying the equation of continuity for stationary currents with a suitable set of boundary conditions, the integral expression of the apparent resistivity at infinite frequency is derived rho/sub infinity,a/ in the case of a horizontally layered earth. Finally, from the definition of the maximum apparent frequency-effect, analytical expressions of fe/sub a/ are obtained for both Schlumberger and dipole arrays placed on the surface of the multi-layered earth section in the most general situation of vertical changes in induced polarization together with dc resistivity variations not at the same interfaces. Direct interpretation

procedures are suggested for obtaining the layering parameters directly from the analysis of the sounding curves.

43772 Fast automatic processing of resistivity soundings. Bichara, M.; Lakshmanan, J. (Compagnie de Prospection Geophysique Francaise, Rueil-Malmaison, France). *Geophys. Prospect.;* **24**: No. 2, 354-370(Jun 1976).

From 36. meeting of the European Association of Exploration Geophysicists; Madrid, Spain (Jun 1974).

The difficulty in using master curves as well as classical techniques for the determination of layer distribution (e/sub i/, rho/sub i/) from a resistivity sounding arises when the presumed number of layers exceeds five or six. The principle of the method proposed here is based on the identification of the resistivity transform. The resistivity transform can be easily derived from the experimental data by the application of Ghosh's linear filter, and another method for deriving the filter coefficients is suggested. For a given theoretical resistivity transform corresponding to a given distribution of layers (thicknesses and resistivities) various criteria that measure the difference between this theoretical resistivity transform and an experimental one derived by the application of Ghosh's filter are given. A discussion of these criteria from a physical as well as a mathematical point of view follows. The proposed method is then exposed; it is based on a gradient method. The type of gradient method used is defined and justified physically as well as with numerical examples of identified master curves. The practical use for the method and experimental confrontation of identified field curves with drill holes are given. The cost as well as memory occupation and time of execution of the program on CDC 7600 computer is estimated.

43773 Combined refraction seismic and gravimetric investigations in a paleogeographical and geological research program. Vandenberghe, J. (Instituut voor Aardwetenschappen, Leuven, Belgium). *Geophys. Prospect.;* **24**: No. 2, 371-379(Jun 1976).

Refraction seismic and gravity investigations were executed to solve geological and hydrographical problems in recent strata. These loose sediments necessitated a special arrangement for the energy source in the seismic measurements. By the use of a falling weight the refracted wave could be registered from a depth of more than 30 m. Quaternary fluviatile sands are characterized by lower velocities than the Tertiary sediments. Even a marked velocity difference between Tertiary formations could be observed. Sand-filled valleys in Tertiary clays give relatively important variations in the gravity field caused by the small differences of densities. Thus buried channels in a clay subsoil can be found by accurate gravity measurements.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

43774 Effect of pre-heating on jet cutting of rocks. McNary, O. (Argonne National Lab., IL). *Int. J. Rock Mech. Min. Sci. Geomech. Abstr.;* **15**: No. 2, 59-68(Apr 1978).

The pre-heating of hard rock before mechanical or hydraulic impact has been proposed as a method of enhancing rock disintegration. A study of the efficiency of surface heating as a function of time leads to the conclusion that the heating time must be short for an economical process. A simple formula allows judgments to be easily made regarding the duration of the heating time. A fundamental principle is developed which states that a critical heating time exists such that the total specific fragmentation energy is a minimum for a heating time equal to the critical time. The total specific fragmentation energy is increased for heating times other than the critical time. Surface heating does not lower the energy requirements in all situations; that is, the critical heating time may be zero in some cases. A study of the relationship of the time of preheating on the rate of kerf cutting yields useful guidelines for defining the conditions under which supplemental heat addition can increase the rate of excavation.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 42301, 42601

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 43760

43775 (SRO—902-6) **Onslow Bay physical/dynamical experiments, Summer-Fall 1975.** Pietrafesa, L.J.; Brooks, D.A.; D'Amato, R.; Atkinson, L.P. (North Carolina State Univ., Raleigh (USA). Center for Marine and Coastal Studies). 1975. Contract EY-76-S-09-0902. 245p. Dep. NTIS, PC A11/MF A01.

Data are presented from measurements of water current velocity, wind velocity, temperature gradients, pressure gradients, and sea level in the vicinity of Onslow Bay, North Carolina, during the summer, fall, and winter of 1975.

43776 Nanolog, a new way to log the resistivity of the sea floor. Beckmann, H.; Demiray, G. *Geophys. Prospect.;* **24**: No. 2, 309-316(Jun 1976).

A new device for resistivity logging was developed with a doubly focussed system. It resembles a simplified double set of microlaterologs. The diagram of the log shows the formation resistivity factor of the sediments on the sea floor. The probe is trailed after the logging boat on a cable with at least two or four cores. The penetration of this log is better than 10 cm. The log is used for resistivity mapping, and it could be used for the exploration of heavy minerals and manganese nodules.

43777 Calibration of marine seismic sources using a hydrophone of unknown sensitivity. Safar, M.H. (British Petroleum Co., Ltd., Sunbury-on-Thames, Middlesex, Eng.). *Geophys. Prospect.;* **24**: No. 2, 328-333(Jun 1976).

The absolute amplitude of the pressure pulse radiated by a marine seismic source is one of the prime criteria used in evaluating its performance. A technique for this measurement is proposed which is applicable to all sources which radiate a bubble pulse. The technique is described with reference to an air-gun array in which the pulse radiated from a single gun is compared with that radiated by the full array. The advantage of the method is that absolute values of pressure are obtained without any need for a calibrated hydrophone. In theory this may seem a trivial advantage but in practice sensitivity factors for the hydrophone channel cannot always be relied upon. The proposed technique is illustrated by an example.

PHYSICS RESEARCH

REFER ALSO TO CITATION(S) 42665

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 43786

STARS

43778 (N—78-10989) **The spectrum of HM Sagittae: a planetary nebula excited by a Wolf—Rayet star.** Brown, L.W.; Feibelman, W.A.; Hobbs, R.W.; Mccracken, C.W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Oct 1977. 15p. (NASA-TM-X—71415; X—685-77-253). NTIS PC A02/MF A01.

Image tube spectrograms of HM Sagittae were obtained. More than 70 emission lines, including several broad emission features, were identified. An analysis of the spectra indicates that HM Sagittae is a planetary nebula excited by a Wolf-Rayet star. The most conspicuous Wolf-Rayet feature is that attributed to a blend of C III at 4650 A and He II at 4686 A.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

43779 (LBL—7227) **Time-resolved spectrophotometry of HZ Herculis and DQ Herculis.** Chanan, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 101p. Dep. NTIS, PC A06/MF A01.

Thesis.

The image-tube scanner at the 3 m telescope at Lick Observatory was employed to study the spectral changes which occur during the pulse period in the optical pulsars HZ Herculis (1.2 s period) and DQ Herculis (71 s period). The data acquisition is described and the tools needed for the data analysis developed. Then the results of the observations are presented. In the case of HZ Herculis (Hercules X-1), observations cover the binary phase interval 0.18 to 0.26 and are concerned only with those pulsations that have been shown (Middleditch and Nelson, 1976) to originate at the x-ray heated surface of the Roche lobe filling companion of the neutron star. It is found that these pulsations are distributed throughout the optical continuum. Observations appear to agree at least qualitatively with the numerical results of other investigators. The observations of DQ Herculis cover one full binary cycle, excluding eclipse. Again pulsations are found distributed throughout the con-

tinuum with generally weak wavelength dependence. However, in this case the emission line lambda 4686 (He II) is more strongly modulated than the underlying continuum and exhibits an unexpected effect: The pulse phase increases rapidly with increasing wavelength across the line. This effect can be understood in terms of a simple model in which the pulsations arise at the inner edge of the accretion disk, excited by radiation which originates at hot spots on the white dwarf and which sweeps around the disk as the degenerate star rotates. A similar model in which the pulsations arise predominantly from the back half of the surface of the disk appears in several respects to be more promising. The evident relation between the phase shift across the emission line and the so-called 360° phase shift through eclipse, discovered by Warner et al. (1972) is also discussed.

43780 (N—78-10995) **Gamma rays from the Magellanic Clouds.** Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1977. 7p. (NASA-TM-X—71409; X—660-77-216). NTIS PC A02/MF A01.

Predicted gamma ray fluxes from the Magellanic Clouds, obtained by using updated parameters, are significantly above the values previously determined, and well within the capabilities of observation from COS-B satellite. Concepts relating galactic gamma ray production and other Population 1 phenomena in the Milky Way were used to postulate a factor of four increase in predicted flux, based on the galactic origin hypothesis. The values obtained provide a possible test of two interpretations of gamma ray emission: enhancement in the inner galaxy from gas and cosmic ray sources alone, or increases produced by the trapping of cosmic rays in spiral arms. Because spiral structure is absent in the small cloud, and questionable in the large cloud, and both clouds are classed as irregular galaxies, the predicted enhancement in gamma ray flux may not be as great in the absence of clear spiral structure.

43781 (N—78-11967) **Soviet-French working group interpretation of the scientific information during the search for celestial sources of gamma pulses, abstract of reports, 24-30 March 1977.** Estulin, I.V. (National Aeronautics and Space Administration, Washington, D.C. (USA)). Oct 1977. Translated from Sovetsko-Frantsuzskii Rabochii Seminar Interpratatsiya Nauchnoy Informatsii Pri Poiske Nebesnykh Istochnikov gamma-Vspleskov. (NASA-TM—75050). 15p. NTIS PC A02/MF A01.

The progress made and techniques used by the Soviet-French group in the study of gamma and X ray pulses are described in abstracts of 16 reports. Experiments included calibration and operation of various recording instruments designed for measurements involving these pulses, specifically the location of sources of such pulses in outer space. Space vehicles are utilized in conjunction with ground equipment to accomplish these tests.

SOLAR PHENOMENA

43782 (AD-A—047612) **Fine-scale radio studies of the Sun. Report for 1 Aug 76—1 Oct 77.** Lang, K.R. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics). 15 Oct 1977. Contract F19628-76-C-0280. 60p. NTIS PC A04/MF A01.

Major flare eruptions in solar active regions create geophysical disturbances which may seriously disrupt Air Force communication and surveillance systems. This report discusses interferometric observations of solar active regions at centimeter wavelengths which show that the emission comes from sources which are only a few seconds of arc in size. The circular polarization of these small-scale features indicates a direct connection with the magnetic fields in active regions. Significant changes in the circular polarization of the fine scale regions only occurs in the few hours prior to flare eruptions. This result suggests that it is changes in magnetic field configurations which trigger flare emission, and that routine observations of the small-scale trigger sources might lead to a reliable flare forecast technique.

43783 (AD-A—047840) **Supposed anticorrelation of solar polar and equatorial rotation rates. Technical report.** Duvall, T.L. Jr; Svalgaard, L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). May 1977. Contract N00014-76-C-0207. 12p. (SU-IPR—702). NTIS PC A02/MF A01.

This report discusses a result that was thought to be caused by correlated variations of the sun's rotation at different latitudes; it is known to be the result of crosstalk between two of the parameters used to fit the differential rotation.

43784 (AD-A—047841) **Observational search for solar pulsations at periods from seven to seventy minutes. Technical report.** Dittmer, P.H. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Aug 1977. Contract N00014-76-C-0207. 37p. (SU-IPR—708). NTIS PC A03/MF A01.

The large-scale solar velocity field has been measured by comparing Doppler shifts from the center and limb of the disk, with the aid of the non-magnetic line FeI 5123.730A. No statistically significant periodicities are observed at periods between seven and seventy minutes. This negative result agrees with other results obtained by observers using spectral techniques, and contrasts with the report of oscillations at similar periods by Hill and co-workers (Hill et al., 1976a; Brown et al., 1976). Hill's explanation of this apparent discrepancy is that his instrument has a greatly enhanced sensitivity to one of two possible modes of oscillation. Independent modeling of the sun's atmosphere confirms that the FFTD technique would have much greater sensitivity to one of the two modes. However, it is concluded that this mode cannot be present in sufficient quantity to explain the apparent discrepancy because of the structure of the sun's atmosphere and because of comparisons of velocity and temperature measurements at different levels of the atmsophere. In addition, questions are raised concerning the statistical significance of the peaks in the SCLERA power spectra.

43785 (AD-A—047842) **Observational search for large-scale organization of five-minute oscillations on the Sun. Technical report.** Dittmer, P.H.; Scherrer, P.H.; Wilcox, J.M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jul 1977. Contract N00014-76-C-0207. 22p. (SU-IPR—809). NTIS PC A02/MF A01.

The large-scale solar velocity field has been measured over an aperture of radius 0.8 R on 121 days between April and Sept. 1976. Measurements are made in the line FeI 5123.730A, by use of a velocity subtraction technique similar to that of Severny et al. (1976). Comparisons of the amplitude and frequency of the five-minute resonant oscillations with the geomagnetic C9 index and magnetic sector boundaries show no evidence of any relationship between the oscillations and coronal holes or sector structure. The average period measured for the five-minute oscillation is 312.0 +- 0.9 sec, which is longer than the average 296.1 +-1.3 sec period originally reported by Noyes and Leighton (1963) from measurements in the line CaI 6103. The average amplitude is 2.0 m/s, which agrees reasonably with the 2.4 m/s value reported by Fossat and Ricort (1975). This amplitude is larger than might have been expected from an extrapolation of the work of Tanenbaum et al. (1969) to a large aperture, and is evidence of a large horizontal wavelength for the oscillations.

43786 (EML—335) **Use of the Wolf number to estimate solar modulation.** O'Brien, K. (Department of Energy, New York (USA). Environmental Measurements Lab.). Dec 1977. 10p. Dep. NTIS, PC A02/MF A01.

An approximate relation between the solar modulation of galactic cosmic rays, in the heliocentric potential model, and the mean annual Zurich sunspot number (Wolf number) was obtained. The heliocentric potential (in MV) is shown to be approximately 4.34 times the Wolf number with a standard deviation of about 160 MV. This ratio allows an estimate of solar activity during periods where neutron monitor data are missing. The mean level of solar activity over the last 10 solar cycles is, based on the mean annual sunspot number, about 200 MV.

43787 (PB—273613) **Compilation of solar flares reported during the Skylab mission. Technical memo.** Hirman, J.; Losey, R.; Heckman, G. (National Environmental Satellite Service, Boulder, Colo. (USA)). Aug 1977. 68p. (NOAA-TM-ERL-SEL—49). NTIS PC A04/MF A01.

Solar flares reported from visual observations in real-time and from film reviews for the Skylab period are listed in conjunction with their x-ray activity. Summaries of activity are listed by both Boulder and McMath region numbers, and also a cross-reference of the Boulder, McMath, and Mt. Wilson region numbers is given. This compilation consists of all the observations of flare activity reported for the period 1 May 1973 - 28 Feb 1974 both from visual observations reported in real time and from film reviews.

43788 (PB—274823) **Solar—geophysical data number 397, September 1977. Part I. (Prompt reports). Data for August 1977—July 1977.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Sep 1977. 123p. (SGD—397-Pt-1). NTIS PC A06/MF A01.

This prompt report provides data for August 1977 on alert periods, daily solar indices, solar flares, solar radio waves, coronal holes, solar x-ray radiation, spacecraft observations, inferred IP magnetic field polarities, mean solar magnetic field, and solar wind measurements. It also provides data for July 1977 on daily solar activity centers, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices.

43789 (PB—274824) **Solar—geophysical data number 397, September 1977. Part II. (Comprehensive reports). Data for March 1977—February 1977 and miscellanea.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Sep 1977. 44p. (SGD—397-Pt-2). NTIS PC A03/MF A01.

This comprehensive report for March 1977, February 1977 and Miscellaneous data provides data on active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles

and plasma, synoptic chart, abbreviated calendar record, regional flare index, solar radio waves for June 1977, and geomagnetic indices for June 1977.

GALAXIES

REFER ALSO TO CITATION(S) 43786

43790 (N—77-33007) **Radial distribution of FE XIV emission in the Cygnus Loop.** Woodgate, B.E.; Kirshner, R.P.; Balon, R.J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1977. 13p. (NASA-TM-X—71393; X—681-77-224). NTIS PC A02/MF A01.

The one dimensional distribution of Fe 14 emission has been determined along a radius of the Cygnus Loop through the use of a tilting filter photometer. The observed emission extends at least 5 arc minutes outside the optical filaments. A simple Sedov solution model of the temperature and density distribution behind the shock agrees with the observations for parameters in reasonable agreement with X-ray maps and optical radial velocities.

PLANETARY PHENOMENA

43791 (LA-UR—78-1211) **Planetary gamma-ray spectroscopy.** Reedy, R.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 49p. (CONF-780314—3). Dep. NTIS, PC A03/MF A01.

From 9. lunar science conference; Houston, TX, USA (Mar 1978).

The chemical composition of a planet can be inferred from the gamma rays escaping from its surface and can be used to study its origin and evolution. The measured intensities of certain gamma rays of specific energies can be used to determine the abundances of a number of elements. The major sources of these gamma-ray lines are the decay of natural radionuclides, reactions induced by energetic galactic-cosmic-ray particles, capture of low energy neutrons, and solar-proton-induced radioactivities. The fluxes of the more intense gamma-ray lines emitted from 30 elements were calculated using current nuclear data and existing models. The source strengths for neutron-capture reactions were modified from those previously used. The fluxes emitted from a surface of average lunar composition are reported for 288 gamma-ray lines. These theoretical fluxes have been used elsewhere to convert the data from the Apollo gamma-ray spectrometers to elemental abundances and can be used with results from future missions to map the concentrations of a number of elements over a planet's surface. Detection sensitivities for these elements are examined and applications of gamma-ray spectroscopy for future orbiters to Mars and other solar-system objects are discussed.

43792 (N—77-33020) **Solar wind sputtering of the Martian atmosphere.** Haff, P.K.; Switkowski, Z.E.; Tombrello, T.A. (Yale Univ., New Haven, Conn. (USA). Nuclear Structure Lab.). Aug 1977. Contracts NGR-05-002-333;EY-76-C-02-2074. 4p. (NASA-CR—155004). NTIS PC A02/MF A01.

The interaction between the solar wind and a planetary atmosphere is evaluated as a cause of atmospheric mass loss. For the case of Mars, calculations suggest that an amount of material has been sputtered which is of the same order as the mass of the present atmosphere.

43793 (N—78-10991) **Acceleration of protons at 32 Jovian radii in the outer magnetosphere of Jupiter.** Schardt, A.W.; Mcdonald, F.B.; Trainor, J.H. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1977. 27p. (NASA-TM-X—71410; X—660-77-225). NTIS PC A03/MF A01.

During the inbound pass of Pioneer 10, a rapid ten-fold increase of the 0.2 to MeV proton flux was observed at 32 Jovian radii (R/sub J/). The total event lasted for 30 minutes and was made up of a number of superimposed individual events. At the time, the spacecraft was in the outer magnetosphere about 7 R/sub J/ below the magnetic equator. Before and after the event, the proton flux was characteristic of the low flux level normally encountered between crossings of the magnetic equator. Flux changes at different energies were coherent within 1 minute a time comparable to the time resolution of the data. The angular distributions were highly anisotropic with protons streaming toward Jupiter. A field-aligned dumbbell distribution was observed initially, and a pancake distribution, just before the flux decayed to its pre-event value. The alpha particle flux changed as rapidly as the proton flux but peaked at different times. The energetic electron flux behaved differently; it increased gradually throughout the period.

43794 (N—78-11959) **Theoretical investigation of isotopic anomalies of xenon in terrestrial and extra-terrestrial samples. Final technical report, 1972—1977.** Sabu, D.D. (Grambling State Univ., La. (USA). Dept. of Chemistry). 1 Jul 1977. 6p. (NGR—19-011-012; NASA-CR—155255). NTIS PC A02/MF A01.

The abundance and isotopic composition of noble gases in meteorites is discussed in relation to the composition of the early solar system. Carbonaceous chondrites contain a unique Xenon-X, which is rich in heavy and light isotopes. Variations in the occurrence of type-X and type-Y (the normal component) noble gases are of such magnitude that neither the injection of material from a nearby supernova nor presence of presolar grains can account for the anomalies in meteorites. Therefore, it is suggested that the entire solar system may have condensed from the debris of a single local supernova.

43795 (N—78-11963) **Mariner 10 magnetic field observations of the Venus wake.** Lepping, R.P.; Behannon, K.W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Aug 1977. 50p. (NASA-TM—78036; X—695-77-206). NTIS PC A04/MF A01.

Magnetic field measurements made over a 21-hour interval during the Mariner 10 encounter with Venus were used to study the down-stream region of the solar wind-Venus interaction over a distance of approximately 100 R sub V. For most of the day before closest approach the spacecraft was located in a sheath-like region which was apparently bounded by planetary bow shock on the outer side and either a planetary wake boundary or transient boundary-like feature on the inner side. The spacecraft made multiple encounters with the wake-like boundary during the 21-hour interval with an increasing frequency as it approached the planet. Each pass into the wake boundary from the sheath region was consistently characterized by a slight decrease in magnetic field magnitude, a marked increase in the frequency and amplitude of field fluctuations, and a systematic clockwise rotation of the field direction when viewed from above the plane of the planet orbit.

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 43788

43796 (AD-A—047376) **Data reduction and auroral characterizations for ICECAP III. HAES report number 59. Final report 1 Dec 75—31 Dec 76.** Kofsky, I.L.; Villanucci, D.P.; Sluder, R.B. (Photometrics, Inc., Lexington, Mass. (USA)). 31 Jan 1977. Contract DNA001-76-C-0161. 204p. (PhM—02-77). NTIS PC A10/MF A01.

This report provides results of infrared radiometry of auroral particle-excited air from two ICECAP multi-instrumented rocket probes and a zenith-viewing aircraft; characterizations of the ionosphere for other simulation tests, an outline of ICECAP's 1976 program of coordinated NKC-135 aircraft and groundbased measurements; and a review of methods for assessing auroral energy inputs. Effective efficiencies for emission of what is interpreted as NO vibrational fundamental and overtone radiation are derived from several rocket probes and aircraft missions. These are consistent among themselves and within the expected precision and resolution of the measurements. The visible-fluorescent and NO-infrared radiances of relatively stable forms appears spatially and temporally correlated. Some indication of a prompt component of 4.25 +- 0.05 micrometer auroral radiation is observed. The spectroscopic and Thomson-scatter radar methods for determining column ionization rates and altitude profiles are reviewed, with a comparison of meridian-plane data from ICECAP 75; it is found that the optical method is effective for aircraft investigations, and that scattering in the lower atmosphere strongly influences results of photometry from ground stations.

43797 (AD-A—047508) **Effective electron density distributions describing vlf/lf propagation data. Technical report Jan 73—Jun 77.** Morfitt, D.G. (Naval Ocean Systems Center, San Diego, Calif. (USA)). 21 Sep 1977. 109p. (NOSC/TR—141). NTIS PC A06/MF A01.

This report presents vlf/lf field strength measurements obtained between 9 and 60 kHz for several radio propagation paths. These include several radials outward from Hawaii, several transmission paths across the continental United States, and high latitude propagation over the Greenland Ice Cap. Effective exponential electron density profiles are derived; these yield predicted signal levels that simulate the experimental data.

43798 (AD-A—047526) **Comparison of ICECAP and EXCEDE rocket measurements with computer code predictions. Final report 9 Oct 74—30 Dec 76.** Hurd, A.G.; Carpenter, J.W.; Degges, T.C.; Grieder, W.F.; Reidy, W.P. (Visidyne, Inc., Burlington, Mass. (USA)). 15 Feb 1977. Contract F19628-74-C-0177. 222p. (VI—381). NTIS PC A10/MF A01.

An analysis is made of rocketborne HAES experiments performed as part of the ICECAP and EXCEDE II test programs. The results are compared to atmospheric emissions from code modelling. Relationships between auroral electron spectra and visible aurora have been determined. Sources of auroral IR are explained.

43799 (AD-A—047823) **Real-time display of ionospheric electron density profiles from a rocket-borne plasma probe: the payload, acquisition system, and the real-time results. Interim report.** Walker, D.N.; Szuszczewicz, E.P.; Holmes, J.C. (Naval Research Lab., Washington, D.C. (USA)). Nov 1977. 21p. (NRL-MR—3649). NTIS PC A02/MF A01.

This is the first in a series of reports dealing with the results of a major DNA program coordinating rocket, satellite, and ground-based equatorial studies at Kwajalein Atoll in the Marshall Islands. This report concentrates on the NRL contribution to the overall program, the direct measurement of the ionospheric plasma state as determined by on-board pulsed-plasma-probe (P3) observations of electron energies, densities, and density fluctuation power spectra. In particular, the authors describe their newly developed data acquisition system which acquired and displayed in real-time the ionospheric electron density profile as it was being measured by the P3 technique during the rocket flight.

43800 (AD-A—047923) **Sunrise E-region enhancements from aurorally increased NO: theory. Final report.** Swider, W.; Keneshea, T.J.; Foley, C.I. (Air Force Geophysics Lab., Hanscom AFB, Mass. (USA)). 15 Sep 1977. 23p. (AFGL-TR—77-0204; AFGL-ERP—608). NTIS PC A02/MF A01.

E-region nitric oxide concentrations are known to be greater at high altitudes as compared to low- and midlatitudes. It is suggested that studies of electron concentration data from ionosondes and/or the Chatanika backscatter radar at night, and especially at sunrise, may be able to provide peak nitric oxide concentrations when aurora are determined to be absent.

43801 (AD-A—047958) **Determination of effective ionospheric electron density profiles for vlf/lf propagation. MEECN technical report.** (Defense Communications Agency, Arlington, Va. (USA)). 1 Jan 1976. 118p. NTIS PC A06/MF A01.

This document is one of a series issued by the DCA/MEECN System Engineer which is directed at definitive prediction of the time availability of VLF/LF radio system included in the MEECN. The studies described in this report are critical to VLF/LF system performance. The tri-Service Propagation program was established by the MEECN System Engineer to improve the accuracy and reliability of VLF/LF link integrity analyses. This report presents experimental data derived from field strengths of VLF/LF signals between 9 and 56 kHz measured on several mid-latitude paths. Comparisons between experimental data and theoretical predications are shown for several flights, both in daytime and in nighttime, over the path from Hawaii to southern California. The comparisons show that an essentially constant exponential electron density profile describes the data for all the frequencies in the above range for daytime; whereas at night, the best fit exponential profile gradient increases with frequency.

43802 (AD-A—048018) **Rocket borne observation of electron density during a travelling ionospheric disturbance. Technical report.** Lloyd, K.H.; Beach, C.J. (Weapons Research Establishment, Salisbury (Australia)). Jun 1977. 20p. (WRE-TR—1828(W)). NTIS PC A02/MF A01.

This report presents measurements of the electron density profile made during a period of intense travelling ionospheric disturbance activity. The electron density profile was determined using a swept frequency r.f. impedance probe, and compared with ionograms from an ionosonde located directly below the rocket trajectory.

43803 (AD-A—048117) **Correlation distance of mean daytime electron content. Air force surveys in geophysics.** Klobuchar, J.A.; Johanson, J.M. (Air Force Geophysics Lab., Hanscom AFB, Mass. (USA)). 22 Aug 1977. 24p. (AFGL-TR—77-0185; AFGL-AFSG—373). NTIS PC A02/MF A01.

In the total electron content (TEC) monitoring station network, an important parameter is the required number of stations for a given percentage improvement over the use of monthly median predicted values. With data from nine TEC stations, taken a pair at a time, values are computed for the correlation coefficient for the 10 to 16 hour local time period when the diurnal values of TEC are generally highest. Little consistent seasonal differences were found in the correlation coefficient values. Thus simple linear relations between station separation and correlation coefficient were chosen for stations having approximate north-south and east-west spacings. For a 50 percent improvement in TEC prediction over a monthly median value, TEC monitoring stations must be spaced approximately 2400 km in longitude and 1600 km in latitude. These values agree reasonably well with previous studies of the correlation distance of the ionospheric parameter foF2.

43804 (N—77-31738) **Present activities in the geophysical compartment.** (Danish Meteorological Inst., Copenhagen). Jan 1976. 133p. NTIS PC A07/MF A01.

Present activities and research projects at the Department for International Affairs, which runs the World Data Center C1 for geomagnetic recordings, are presented together with activities at the Geophysical Department 1 concerning determination of the earth magnetic field over Denmark; real time recording of weather-data transmitted from satellites; and measurements of diurnal and yearly variation of the electron content in the atmosphere within the auroral oval. Work carried out at Geophysical Department 2 is also discussed and involves routine geomagnetic observations from observatories in Greenland (Narssarssuaq - Godhavn - Thule); study of currents in the polar ionosphere and their relation with the interplanetary magnetic field; and investigations of the geographic distribution of precipitation of auroral particles (mainly electrons in the range of 100 eV to 50 keV.)

43805 (N—77-32660) **Atomic oxygen between 80 and 120 km: evidence for a rapid spatial variation in vertical transport near the ionosphere. Final technical report, September 1976—August 1977.** Donahue, T.M.; Wasser, B. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). Aug 1977. 46p. (NASA-CR—155009). NTIS PC A03/MF A01.

Analysis of OGO-6 OI green line photometer results was carried out for 8 cases when the alignment of the spacecraft was such that local emission rates could be determined below the altitude of maximum emission and down to about 80 km. Results show a variation on a scale of 6 deg to 8 deg in latitude between regions where the emission rate increases rapidly between 90 and 95 km and regions where it increases slowly from 80 km to 95 km. Latitude-altitude maps of iso-emissivity contours and iso-density contours for oxygen concentration are presented. The latter are computed under 3 assumptions concerning excitation mechanisms. Comparisons of the spatial variations of oxygen density with the results of a time dependent theory suggest the regions of strong downward transport alternate on a scale of about 1000 km with regions of weak transport near 90 km. In the first case conversion of O to O_3 at night appears to be overwhelmed by downward transport of O.

43806 (PB—275095) **Geomagnetic data for February 1976 (AE (7) indices and stacked magnetograms).** Allen, J.H.; Abston, C.C.; Morris, L.D. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Sep 1977. 62p. NTIS PC A04/MF A01.

This is the second of a series of data reports in support of the International Magnetospheric Study (IMS) and includes selected geomagnetic variation data for February 1976; the first (UAG-60) gave similar data for January 1976. Included herein are analog records from seven auroral zone stations, preliminary AE indices based on these data and various related tables, graphs and statistics. It is expected that this series will continue on an increasingly timely schedule and with data from additional stations which may be processed in time for publication.

43807 (PB—275096) **Geomagnetic data for March 1976 (AE (7) indices and stacked magnetograms).** Allen, J.H.; Abstron, C.C.; Morris, L.D. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Sep 1977. 65p. NTIS PC A04/MF A01.

This is the third of a series of data reports in support of the International Magnetospheric Study (IMS) and includes selected geomagnetic variation data for March 1976; the first (UAG-60) gave similar data for January 1976. Included are analog records from seven auroral zone stations; preliminary AE indices based on these data; and various related tables, graphs, and statistics.

EFFECTS OF NUCLEAR DETONATIONS

43808 (AD-A—047395) **Uhf propagation effects in scintillated environments. Final report.** Wittwer, L.A.; Salvi, T.; Pettus, E. (Air Force Weapons Lab., Kirtland AFB, N.Mex. (USA)). Aug 1977. 70p. (AFWL-TR—76-304). NTIS PC A04/MF A01.

Calculational methods for examining the effects of striations on UHF signals are presented. The advantages of each method are discussed. Calculations are presented which illustrate the various expected effects on signals from different striation structures. The calculations demonstrate that for ambient environments Rayleigh signal statistics are a reasonable worst case representation. It is also shown that for most cases of interest the ionospheric fluctuation power spectral density or its equivalent is necessary and sufficient to calculate the required signal effects.

43809 (AD-A—047975) **Propagation in striated media. Topical report Apr—May 76.** Hendrick, R.W.; Shaeffer, L. (Mission Research Corp., Santa Barbara, Calif. (USA)). May 1976. Contract DNA001-76-C-0135. 82p. (MRC-R—118). NTIS PC A05/MF A01.

The propagation of radar through a striated plasma has been analyzed on the basis of random walk photon scattering, geometric optics refraction at a thin phase screen, plane-wave scattering from a thin screen in the Fraunhofer limit, and the observables to a monopulse system by use of a wave front integration implementation of Huygens' principle over a thin phase screen. The latter two were carried out for screens of both large and small phase variance. The scattering was related to the properties of the plasma for a variety of distribution functions of striation sizes. For reasonable distributions, a similar 'effective' striation size is obtained. This allows the calculation of the angular variance of the scattered power which is gaussianly distributed for most significant cases. In the geometric optics regime the distribution of density of allowable multipath rays is gaussianly distributed and the power distribution is identical for all rays. The signal processor sees an unmodified but attenuated component and a random-phased, scattered component that leads to Rician amplitude statistics. The results of the various approaches are all compatible and furnish a single unified description of the perturbed signal.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 43788

43810 (N—77-32879) **Reply in response to comment by E. W. Hones.** Frank, L.A.; Decoster, R.J.; Ackerson, K.L. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Aug 1977. Contracts NAS5-11064;NGL-16-001-002. 16p. (NASA-CR—149826; U-OF-IOWA—77-3). NTIS PC A02/MF A01.

Hones [1977] points out the marked disagreement between the plasma flow measurements reported by Frank et al. [1976] and those obtained with the LASL plasma analyzer. He suggests (1) that solar ultraviolet background rates may have been incorrectly accounted for in the computation of proton bulk flows in the magnetotail as reported by Frank et al. 1976 and (2) that bulk flows with substantial speeds, i.e., those speeds greater than 50 km per sec, are seldom encountered in the plasma sheet at geocentric radial distances approx. equal to 35 R/sub E/. It is demonstrated that such ultraviolet responses were carefully considered by Frank et al. 1976 and thus the conclusion is maintained that bulk flows greater than 50 km per sec frequently occur in the plasma sheet at these radial distances. Further, a direct comparison of the capabilities of the LASL plasma analyzer employed by Hones and of the LEPEDEA [Frank et al., 1976] indicates that there are rather severe restrictions on which plasmas in the plasma sheet can be properly measured to gain proton temperatures, number densities and flow velocities with the LASL plasma analyzer.

43811 (N—78-10646) **Ionospheric and magnetospheric plasmapauses'.** Grebowsky, J.M.; Hoffman, J.H.; Maynard, N.C. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Oct 1977. 34p. (NASA-TM-X—71416; X—621-77-257). NTIS PC A03/MF A01.

During August 1972, Explorer 45, orbiting near the equatorial plane with an apogee of about 5.2 R/sub e/, traversed magnetic field lines in close proximity to those simultaneously traversed by the topside ionospheric satellite ISIS 2 near dusk in the L range 2-5.4. The locations of the Explorer 45 plasmapause crossings during this month were compared to the latitudinal decreases of the H^+ density observed on ISIS 2 near the same magnetic field lines. The equatorially determined plasmapause field lines typically passed through or poleward of the minimum of the ionospheric light-ion trough, with coincident satellite passes occurring for which the L separation between the plasmapause and trough field lines was between 1 and 2. Vertical flows of the H^+ ions in the light ion trough as detected by the magnetic ion mass spectrometer on ISIS were directed upward with velocities between 1 and 2 kilometers/sec near dusk on these passes. These velocities decreased to lower values on the low latitude side of the H^+ trough but did not show any noticeable change across the field lines corresponding to the magnetospheric plasmapause.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

43812 (N—77-32857) **Energy spectrum of sputtered uranium.** Weller, R.A.; Tombrello, T.A. (California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.). 1977. Contracts NGR-05-002-333;NSF PHY-76-83685. 27p. (NASA-CR—155037). NTIS PC A03/MF A01.

The fission track technique for detecting uranium-235 was used in conjunction with a mechanical time-of-flight spectrometer to measure the energy spectrum in the region 1 eV to 1 keV of material sputtered from a 93% enriched U-235 foil by 80 keV $^{40}Ar^+$ ions. The spectrum was found to exhibit a peak in the region 2-4 eV and to decrease approximately as E to the -1.77 power for E greater than approximately 100 eV. The design, construction and resolution of the mechanical spectrometer are discussed, and comparisons are made between the data and the predictions of the random collision cascade model of sputtering.

43813 (N—78-10881) **Extraction of a long-pulsed intense electron beam from a pulsed plasma based on hollow cathode discharge.** Uramoto, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1977. 30p. (IPPJ—288). NTIS PC A03/MF A01.

An intense electron beam was extracted along a uniform magnetic field with a long decay time from a pulsed high-density plasma source which is produced with a fast rise time by a secondary discharge based on a dc hollow cathode discharge. Through a back stream of ionized ions from a beam-extracting anode region where a neutral gas was fed, a space charge limit of the electron beam was so reduced that the beam current was determined by an initially injected electron flux and concentrated in a central aperture of the extracting anode. Moreover, the beam pulse width was much extended by the neutral gas feed into the anode space.

43814 **Comparison of vicinage effects in ion cluster penetration in gases and in condensed matter.** Basbas, G. (North Texas State Univ., Denton (USA); Oak Ridge National Lab., Tenn. (USA)); Ritchie, R.H. (Oak Ridge National Lab., Tenn. (USA); Tennessee Univ., Knoxville (USA)). pp 626-627 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43815 (N—78-11231) **Evolution of ion emission yield of alloys with the nature of the solute. 2: interpretation.** Blaise, G.; Slodzian, G. Translated from *J. Phys. (Paris);* **35**: No. 3, 243-261(Mar 1974). 44p. (NASA-TM—75180). NTIS PC A03/MF A01.

Solid solutions of transition elements in copper, nickel, cobalt, iron, and aluminum matrices were analyzed by observing secondary ion emissions under bombardment with 6.2-keV argon ions. Enhancement of the production of solute-element ions was observed. An ion emission model is proposed according to which the ion yield is governed by the probability that an atom leaves the metal in a preionized state. The energy distribution of the valence electrons of the solute atoms is the basis of the probability calculation.

ATOMIC AND MOLECULAR PROPERTIES

43816 (LA—7071-MS) **Derived thermodynamic properties for fluid n-T_2 in the range 75 to 300 K and 2 to 20 kbar.** Liebenberg, D.H.; Mills, R.L.; Bronson, J.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

The tritium equation of state, extended from measurements of the lighter hydrogen isotopes, is used to derive thermodynamic properties of tritium fluid. Tabular values are given at rounded kbar pressures and 25°K temperature intervals in the range 75 to 300°K and 2 to 20 kbar. Included are the isobaric thermal expansion coefficient α/sub p/, the molar heat capacity at constant pressure C/sub p/, adiabatic compressibility coefficient chi/sub s/, heat capacity ratio γ, and molar entropy S. Computer-drawn graphs of these variables vs pressure along five isotherms are shown.

43817 **Equilibrium charge-state fractions for 2.7-31 keV deuterium atoms and ions in strontium vapor.** Berkner, K.H.; Leung, D.; Pyle, R.V.; Schlachter, A.S.; Stearns, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., A;* **64**: No. 2, 217-218(12 Dec 1977).

Equilibrium charge-state fractions of 2.7-31 keV deuterium in strontium vapor are reported. The energy dependence of the D^- equilibrium yields is discussed. The results are compared with the D^- yield in cesium and magnesium vapors.

43818 **Time resolved VUV spectroscopy using synchrotron radiation: fluorescent lifetimes of atomic Kr and Xe.** Matthias, E.; Rosenberg, R.A.; Poliakoff, E.D.; White, M.G.; Lee, S.T.; Shirley, D.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Chem. Phys. Lett.;* **52**: No. 2, 239-244(1 Dec 1977).

Synchrotron radiation from the Stanford positron electron accelerator ring (SPEAR) was used to excite the $np^5(n+1)s$ states in Kr(n = 4) and Xe (n = 5). Utilization of the excellent time structure of this facility made possible the first direct measurement of the lifetimes of these states. The results for Kr are (in jl coupling notation): tau(5s[3/2]1)=3.18+-0.12 ns; tau (5s[1/2]1)=3.11+-0.12 ns; for Xe, tau(6s[3/2]1)=3.46+-0.09 ns; tau(6s[1/2]1)=3.44+-0.07

ns. In addition the lifetime of the Xe $5p^5[3/2]5d[3/2]$ J = 1 state was found to be 1.40+- 0.07 ns. Effects due to radiation trapping are discussed.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 43684

43819 (AD-A—045902) **Theoretical studies on excited molecular vibrational states. Final report, 1 November 1975—30 June 1977.** Ritchie, A.B.; Tambe, B.R. (Alabama Univ., University (USA)). Oct 1977. 29p. NTIS PC A03/MF A01.

Calculations are performed for the scattering of electrons from H_2^+ in the fixed-nuclei approximation. It is assumed that amplitudes for rotationally and vibrationally inelastic scattering can be constructed if one knows the parameters of the elastic scattering for the fixed nuclei adiabatic nuclei theory; thus, emphasis has been on the determination of accurate elastic scattering parameters in the fixed-nuclei approximation. The hydrogen molecular ion was chosen as a prototype target because its states are known exactly (in the Born-Oppenheimer theory) or can be represented accurately using variational theory. Calculations are carried out for coupled and uncoupled single-center partial waves. Significant disagreement with earlier work is obtained based on the projection technique used to obtain the static-exchange potential. In particular the p-wave phase shifts (or eigenphases in the coupled approximation) are significantly smaller when the projection onto the space of the target electron is made with the full target ls(sigma/sub g/) eigenstate, rather than only its zeroth-order component.

43820 (AD-A—046245) **Electron-atom and electron-molecule cross sections applicable to atmospheric and ionospheric behavior. Final report, 1 July 1970—30 June 1976.** Hughes, V.W. (Yale Univ., New Haven, Conn. (USA)). 25 Oct 1977. Contract N00014-76-C-0077. 7p. NTIS PC A02/MF A01.

Polarized electrons have been produced by photoionization of polarized alkali atoms by unpolarized light and also by photoionization of unpolarized alkali atoms by polarized light (Fano effect). Practical sources based on these approaches have been made. The first experiment to study the low energy scattering of polarized electrons by polarized atoms (electron-hydrogen) has been done with the Fano effect source. The other source provides polarized electrons for acceleration to high energies at SLAC and has been used in basic pioneering experiments in elementary particle physics. The atomic scattering studies with polarized electrons improve our understanding of the approximations in theoretical calculations of electron-atom scattering cross section.

43821 (AD-A—047189) **Penning ionization: measurement of ion and molecular lifetimes. Report No. 11 (annual), 1 Dec 76—1 Dec 77.** Schearer, L.D.; Parks, W.F. (Missouri Univ., Rolla (USA)). 1 Dec 1977. Contract N00014-75-C-0477. 57p. NTIS PC A04/MF A01.

Contents: Intense Flowing Hollow-Cathode Lamp, Radiative Lifetime of the A(2) Delta State of CH; Spin and Coherence Transfer in Penning Ionization; A High Flux Beam Source of Fast Neutral Helium Atoms; A Xenon-ion Laser Pumped Blue Dye Laser; Polarization of the $^1P_1$ Resonance Levels of Group II Atoms in Collision with 1 keV Helium Atoms; Investigation of Volume Recombination Kinetics in an Alkali-Noble Gas Afterglow of a High Power, Fast Laser Pulse.

43822 (AD-A—047624) **Study of chemiluminescent reactions of metal atoms. Final technical report 28 Jul 76—28 Nov 77.** Friichtenicht, J.F.; Tang, S.P.; Wicke, B.G. (TRW Defense and Space Systems Group, Redondo Beach, Calif. (USA)). 28 Nov 1977. Contract N00173-76-C-0258. 81p. NTIS PC A05/MF A01.

Laser vaporization of thin metal films has been used as the metal atom beam source for the study of chemiluminescent oxidation reactions. Techniques have been developed and demonstrated to determine experimentally the chemiluminescent reaction stoichiometry, the relative chemiluminescent cross section vs. kinetic energy, the total scattering cross section vs. kinetic energy, the total reactive cross section (under favorable conditions), the chemiluminescent spectrum and radiative lifetimes of chemiexcited species with lifetimes in the approximate range 10-100 μs. The versatility of the laser vaporization metal beam source has been demonstrated by obtaining the chemiluminescent spectra for the N_2O oxidation of twenty different metal atoms under essentially identical experimental conditions. A definitive measurement of a long lived chemiexcited state has been made for the Pb + N_2O reaction; screening tests on Sn, Mo, and Ge oxidation by N_2O suggest these reactions also produce long-lived excited states.

43823 (AD-A—048230) **Reactive single collision studies with metal atoms or metal halides. Interim report.** Herm, R.R. (Aerospace Corp., El Segundo, Calif. (USA). Chemistry and Physics Lab.). 14 Nov 1977. Contract F04701-77-C-0078. 120p. NTIS PC A06/MF A01.

Molecular beam studies at low energy (typically < or = 100 kJ/mole) of reactive scattering of metal atoms, metal dimers, or metal halides from a variety of halide molecules are reviewed. Studies of vibrationally inelastic scattering of alkali halides are also reviewed.

43824 (BNWL—2100(Pt.4), pp 30-51) **Radiation physics.** Jun 1977.

In Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part IV. Physical and technological programs.

The Radiation Physics Program is directed toward providing information on the initial interactions by which ionizing radiation transfers energy to biologically significant matter and the subsequent transport and degradation of that energy. Measurement of differential ionization cross sections test theoretical descriptions of the ionization process and present the data base required for the development of track structure models used in the study of energy transfer and radiation damage. Theoretical studies of the energy transfer processes in gas and liquid systems are direted toward connecting knowledge of the basic interaction cross sections with measurements of fluorescence and fluorescence lifetimes in liquids. These investigations of the liquid system include such studies as the quenching of excited states by formation of transient chemical species and the correlation of the LET of the excitation source with the observed fluorescence. This closely correlated program of theoretical studies in energy transfer, measurements of time resolve fluorescence of binary liquid systems, and measurements of initial interaction probabilities utilizing gas targets is expected to provide insight into the mechanisms of radiation damage to biological systems.

43825 (N—77-31934) **Photon scattering cross sections of H_2 and He measured with synchrotron radiation.** Ice, G.E. (Oregon Univ., Eugene (USA). Dept. of Physics). 1977. Contract NGR-38-003-036. 35p. (NASA-CR—155010). NTIS PC A03/MF A01.

Total (elastic + inelastic) differential photon scattering cross sections have been measured for H2 gas and He, using an X-ray beam. Absolute measured cross sections agree with theory within the probable errors. Relative cross sections (normalized to theory at large S) agree to better than one percent with theoretical values calculated from wave functions that include the effect of electron-electron Coulomb correlation, but the data deviate significantly from theoretical independent-particle (e.g., Hartree-Fock) results. The ratios of measured absolute He cross sections to those of H2, at any given S, also agree to better than one percent with theoretical He-to-H2 cross-section ratios computed from correlated wave functions. It appears that photon scattering constitutes a very promising tool for probing electron correlation in light atoms and molecules.

43826 (N—78-11808) **Analytical representation of elastic scattering cross sections of low energy electrons by atmospheric gases.** Ivanov, V.Y.; Sipov, N.K.; Shneyder, V.A. Sep 1977. Translated from Analitichaskoye Predstavleniya Sechanii Uprugogo Rasseyaniya Elektronov Malykh Energii Atmosfernymi Gazami, Geomagnetism I Aeronomiya. (NASA-TM—75194). 9p. NTIS PC A02/MF A01.

Analytical representations of the elastic scattering cross sections of electrons with energies of 0.01-1 keV in atmospheric gases of N_2, O_2, O are given. These representations are suitable for the Monte Carlo method.

43827 (SAND—78-0580) **Improved atomic shell excitation and relaxation in the TIGER series codes.** Halbleib, J.A. Sr.; Morel, J.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 64p. Dep. NTIS, PC A04/MF A01.

A new version of the TIGER Monte Carlo electron/photon transport code that more accurately models the transport for problems where atomic-shell effects are important is documented. The new model includes both electron impact ionization and photoionization of the K, L1, L2, L3, M (average) and N (average) shells, as well as a description of the subsequent atomic relaxation cascade. The relevant physical theories are essentially equivalent to those currently being employed in the SANDYL code. Because these modifications are only incidentally affected by the problem geometry, they can easily be extended to other codes in the TIGER series.

43828 **Inelastic differential cross sections for electron-impact excitation of argon.** Chutjian, A. (California Inst. of Tech., Pasadena (USA)); Cartwright, D.C. (Los Alamos Scientific Lab., N.Mex. (USA)). pp 432 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43829 Electron capture to K vacancies in chlorine ions (approximately 1.5MeV/amu); relation to emergent charge states. Datz, S.; Moak, C.D.; Dittner, P.F.; Gomez del Campo, J.; Miller, P.D.; Biggerstaff, J.A. (Oak Ridge National Lab., Tenn. (USA)). pp 630-631 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43830 Theory of low-energy electron-molecule collisions: a comparison of electron-CO_2 and electron-N_2 elastic and rotational-excitation cross sections. Morrison, M.A. (Los Alamos Scientific Lab., N.Mex. (USA)); Collins, L.A. (Colorado Univ., Boulder (USA); National Bureau of Standards, Boulder, Colo. (USA)); Lane, N.F. (Rice Univ., Houston, Tex. (USA). Dept. of Physics). pp 478-479 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43831 Electron transfer between multicharged ions and atomic hydrogen. Phaneuf, R.A.; Meyer, F.W.; McKnight, R.H.; Crandall, D.H. (Oak Ridge National Lab., Tenn. (USA)). pp 524-525 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43832 Recoil ion spectroscopy in the XUV - soft X-ray region following heavy ion impact on thin gas targets. Sellin, I.A.; Elston, S.B.; Forester, J.P.; Griffin, P.M.; Pegg, D.J.; Peterson, R.S.; Thoe, R.S.; Vane, C.R.; Wright, J.J. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). pp 634-635 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43833 Bessel function representation for semiclassical perturbation scattering. Smith, F.T. (Stanford Research Inst., Menlo Park, Calif. (USA)); Miller, W.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 484-485 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43834 Electron impact excitation cross sections for Kr at 15, 30, 50 and 100eV. Srivastava, S.K.; Trajmar, S. (California Inst. of Tech., Pasadena (USA)); Cartwright, D.C. (Los Alamos Scientific Lab., N.Mex. (USA)). pp 430-431 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

43835 Experimental and theoretical study of electron impact excitation of Cu. Trajmar, S.; Williams, W.; Srivastava, S.K. (California Inst. of Tech., Pasadena (USA)); Winter, N.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 442-443 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

ATOMIC AND MOLECULAR THEORY

43836 (AD-A—047569) **Atomic inner-shell transitions. Final report 1 Nov 74—31 Oct 77.** Crasemann, B. (Oregon Univ., Eugene (USA). Dept. of Physics). 31 Oct 1977. 11p. NTIS PC A02/MF A01.

The research described in this Final Report includes theoretical studies of the deexcitation of multiply ionized atoms; extensive computations of binding and transition energies including relaxation, relativistic, and quantum-electrodynamic effects, and experimental studies of electron correlation through x-ray scattering with synchrotron radiation.

MAGNETOHYDRODYNAMICS

43837 (N—77-31457) **Distortion of a crossed magnetic field by the flow of an inviscid conducting fluid past a sphere.** Smith, R. (Loughborough Univ. of Technology (UK). Dept. of Mathematics). Mar 1976. 25p. (MATHS-RES—95). NTIS PC A02/MF A01.

The flow of an inviscid incompressible fluid past a nonconducting sphere was considered for cases in which the ratio of the magnetic to dynamic pressure beta is small, which implies that the velocity field is only slightly distorted from its value when the fluid is nonconducting. The magnetic Reynolds number, Rm, is assumed small in the first part of the analysis; however, a solution for infinite Rm is also given. The method of solution for small Rm, more specifically $0 < \text{or} = \text{to} \ \beta < \text{or} = \text{to Rm}, < \text{or} = \text{to 1}$, is to develop an inner Stokes expansion near the sphere and an outer Oseen expansion valid at great distances.

HIGH ENERGY PHYSICS

REFER ALSO TO CITATION(S) 43091

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

43838 (SLAC—207) **Anomalous electron—muon and electron—hadron production in electron—positron annihilation.** Kwan, B.P. (Stanford Linear Accelerator Center, Calif. (USA)). Apr 1978. Contract EY-76-C-03-0515. 132p. Dep. NTIS, PC A07/MF A01.

Results of studies of anomalous electron-muon and electron-hadron events produced in electron-positron annihilation are presented. The data for this work were obtained with a lead-glass counter system, which was added to one octant of the Stanford Linear Accelerator Center-Lawrence Berkeley Laboratory magnetic detector at the electron-positron storage ring SPEAR. The lead-glass counter system provides good electron identification for part of the magnetic detector. The events under study have two detected charged particles and any number of detected photons. One detected charged particle is identified as an electron in the lead-glass counter system. The other detected charged particle is identified as a muon or hadron in the magnetic detector. Anomalous events are events which are not subject to conventional explanations; examples of conventional explanations are misidentification of particles or the decay of ordinary or strange hadrons. These data confirm previous observations of anomalous lepton production at SPEAR and DESY. The data corrected for charm background are consistent with heavy lepton production and decay. The branching ratio for the heavy lepton to decay into an electron and two neutrinos was measured to be 0.21 +- 0.05. The branching ratio for the heavy lepton to decay into one charged hadron, one neutrino and any number of photons was measured to be 0.28 +- 0.13. They are consistent with the theoretical values within the errors.

43839 (SLAC-PUB—2086) **e^+e^--production of charmed particles at the spear magnetic detector.** Lueke, D. (Stanford Linear Accelerator Center, Calif. (USA)). 1977. Contract EY-76-S-03-0326. 8p. (CONF-771089—6). Dep. NTIS, PC A02/MF A01.

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Some recent experimental results on charmed particles produced in e^+e^- annihilation are presented. Some new properties of the charmed mesons D^0 and D^+, some preliminary results on a search for the charmed meson F in $e^+e^- \rightarrow F^+F^-$, and the inclusive yields of antiprotons and lambdas as a function of the center of mass energy for an indication of production of charmed baryons are covered. 12 references. (JFP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 43838

43840 (ANL-HEP-CP—78-10) **A_1 resonance in tau decay.** Basdevant, J.L.; Berger, E.L. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 6p. (CONF-780453—3). Dep. NTIS, PC A02/MF A01.

From Neutrinos; West Lafayette, IN, USA (28 Apr 1978).

It is shown that the observation of the A_1 resonance in tau decay agrees with diffractive A_1 production and that it confirms previous analysis of the diffractive data.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 43839

43841 (ORO—1316-200) **Nuclear structure at intermediate energies. Progress report, April 1, 1977—March 31, 1978.** Phillips, G.C.; Mutchler, G.S. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). 1978. Contract EY-76-C-05-1316. 54p. Dep. NTIS, PC A04/MF A01.

Work in intermediate-energy physics is summarized. The emphasis was on data acquisition and analysis; significant improvements in detector technology, data capture programs, and system hardware resulted in improvements in data collection. Much of the work summarized here has been reported at scientific meetings and/or prepared for publication. The topics presented are the following: two-nucleon physics, three-nucleon physics, several-nucleon physics, theory, instrumentation, and applied physics. 26 figures, 4 tables. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

WEAK INTERACTIONS

43842 **Source of trimuon events in neutrino scattering.** Barnett, R.M.; Chang, L.N. (Stanford Linear Accelerator Center, Calif. (USA)). *Phys. Lett., B;* **72**: No. 2, 233-236(19 Dec 1977).

A comprehensive study indicates that equally likely sources for trimuon events in neutrino scattering are (a) charged heavy lepton production (with decay to three muons) and (b) simultaneous production of a neutral lepton (with decay to two muons) and a heavy quark (with decay to one muon). The sequential decay of a heavy quark to two muons is less likely . An intriguing model yielding simultaneous M^0 and b quark production is proposed.

STRONG INTERACTIONS, BARYON NO.=0

43843 **Baryonium mass spectrum in a planar bootstrap model.** Balazs, L.A.P. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics); Nicolescu, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **72**: No. 2, 240-244(19 Dec 1977).

A simple planar self-consistent multiperipheral model with a finite-energy sum-rule constraint is used to generate, without any free parameters, two infinitely-rising baryonium trajectories. One of these is dual to vector and the other to pseudo-scalar meson exchange.

FIELD THEORY

43844 **Structure of the Yang-Mills vacuum in the Coulomb gauge.** Abbott, L.F.; Eguchi, T. (Stanford Linear Accelerator Center, Calif. (USA)). *Phys. Lett., B;* **72**: No. 2, 215-218(19 Dec 1977).

The non-uniqueness of Yang-Mills potential in the Coulomb gauge leads to a non-trivial vacuum structure featuring vacuum fields of both integer and half-integer topological charge. Instantons fit in consistently with this picture and their interpretation is not changed. Integer and half-integer vacua are connected by certain meron solutions and the existence of half-integer charged states appears to be important for the confinement properties of the theory.

43845 **Self-consistent β functions in asymptotically free massless field theory.** Abarbanel, H.D.I. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). *Nucl. Phys., B;* **130**: No. 1, 29-37(7 Nov 1977).

In massless field theory with asymptotic freedom a spontaneous mass may be generated through renormalization. This mass is non-analytic in the coupling and via the renormalization group is connected with the usual β function. The development of the β function itself in renormalized perturbation theory provides another connection with the spontaneous mass. In a two-dimensional field theory of four-fermion coupling which is asymptotically free, these connections are exploited to find the infrared behavior of the theory. An argument is made on how the results carry over to all orders of perturbation theory.

SCATTERING THEORY

43846 **Analyticity and duality in the OZI rule violation.** Kwiecinski, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **72**: No. 2, 245-248(19 Dec 1977).

Mutual relationship between the Steinmann decomposition and different contributions to certain OZI rule violating Reggeon couplings is discussed. It is shown that only the mixing term contributes to the decay coupling constant when the Reggeon is on shell.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

43847 (LA—7200-PR) **Applied nuclear data research and development. Progress report, October 1—December 31, 1977.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 54p. Dep. NTIS, PC A04/MF A01.

This progress report describes the activities of the Los Alamos Nuclear Data Group for the period October 1 through December 31, 1977. The work can be grouped into three broad categories: theory and evaluation of nuclear cross sections; nuclear cross section processing; and fission products and actinides: yields, yield theory, decay data, depletion, and build-up. 15 figures, 19 tables.

43848 (LBL—6575) **Nuclear science. Annual report, July 1, 1976—June 30, 1977.** Conzett, H.E.; Myers, W.D.; Schroeder, L.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1977. Contract W-7405-ENG-48. 288p. Dep. NTIS, PC A13/MF A01.

Brief reports (ca 2 pages in length) summarize research in experimental and theoretical aspects of nuclear structure, reactions and scattering. Experimental heavy-ion reactions (projectile and target fragmentation, central collisions) and atomic physics and the quark search are included. Reports are also provided on accelerator operations and development and nuclear instrumentation. Thesis abstracts and publications lists complete the volume. It is safe to assume that work reported here will be published upon completion; indeed, many of the reports are indicated as condensations of works accepted for publication or already published. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

43849 (BNL—22742) **Much ado about nothing: deep minima in ^{45}Sc and ^{56}Fe total neutron cross sections.** Chrien, R.E.; Liou, H.I.; Block, R.C.; Singh, U.N.; Kobayashi, K. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 6p. (CONF-770321—10). Dep. NTIS, MF A01.

From NBS international specialists symposium on neutron standards and applications; Gaithersburg, MD, USA (28 Mar 1977).

Portions of document are illegible.

The deep minima in ^{45}Sc and ^{56}Fe neutron total cross sections were measured at the Gaerttner Linac Laboratory by using thick, ultra-pure samples in transmission experiments. The samples are used to produce quasi-monoenergetic beams at the BNL High Flux Beam Reactor. For the ^{45}Sc minimum near 2.05 keV we obtain sigma/sub total/ = 0.71 +- 0.03 barns, in sharp contrast to a previously reported value of approximately 0.05 barns. The ^{56}Fe measurement was carried out with a 6 kg, 68.58-cm-long sample of 99.87% isotopically pure sample of ^{56}Fe; a minimum cross section of 0.0085 +- 0.004 barns at 24.39 keV is inferred. This may be compared to a value of 0.420 barns for natural iron.

NUCLEAR PROPERTIES AND REACTIONS,

A=59-89, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

43850 (IS—4361) **Realistic nuclear shell theory and the doubly-magic ^{132}Sn region.** Vary, J.P. (Ames Lab., Iowa (USA)). Mar 1978. Contract W-7405-ENG-82. 39p. Dep. NTIS, PC A03/MF A01.

Realistic nuclear shell theory, the union of the nuclear shell model with realistic nucleon-nucleon potentials through Brueckner theory, is outlined. A brief historical review of some key developments from 1962 to 1977 is presented. This includes recent applications which indicate that careful calculation of realistic Hamiltonians through low orders will provide descriptions of nuclear behavior which achieve reasonable accord with experiment. Currently available theoretical Hamiltonians are described and results for nuclei from oxygen to lead are discussed. It is argued that experimental results in the ^{132}Sn region would be especially valuable for testing the next generation of realistic nuclear shell theory Hamiltonians.

NUCLEAR REACTIONS AND SCATTERING

43851 (LBL—7164) **High energy collisions of nuclei: experiments.** Heckman, H.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1977. Contract W-7405-ENG-48. 27p. (CONF-770987—4). Dep. NTIS, PC A03/MF A01.

From International symposium on nuclear collisions and their microscopic description; Bled, Yugoslavia (26 Sep 1977).

Heavy-ion nuclear reactions with projectile energies up to 2.1 GeV/A are reviewed. The concept of "rapidity" is elucidated, and the reactions discussed are divided into sections dealing with target fragmentation, projectile fragmentation, and the intermediate region, with emphasis on the production of light nuclei in high-energy heavy-ion collisions. Target fragmentation experiments using nuclear emulsion and AgCl visual track detectors are also summarized. 18 figures. (RWR)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 43850

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 43850

43852 (ZfK—336, pp 96-97) **Isomeric trapping following Coulomb excitation of high spin states in ^{178} ^{180}Hf.** Hamilton, J.H.; Ramayya, A.V.; Ronningen, R.M.; Sayer, R.O. (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Physics); Colombani, P.; Ward, D.; Diamond, R.M.; Stephens, R.S.; Lee, I.Y.; Butler, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1977.

In Contributed papers of the international symposium on high-spin states and nuclear structure.

Coulomb excitation of ^{178} ^{180}Hf yrast states has been observed to 14^+ and 12^+, respectively, with Kr and Xe ions. Lifetimes of the 6^+ to 14^+ states were extracted. The 14^+ lifetimes in ^{178}Hf is 50% longer than that predicted by the rotational model to suggest band crossing. For the first time in Coulomb excitations, population of the Ksup(π) = 8^- isomer in ^{178}Hf was observed. This indicates that above spin 8^+ in the gsb one reaches a level that is sufficiently mixed to allow branching of the 8^- isomer.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 43851

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

43853 (AD-A—047373) **Implementation study of SAM-IV on the ILLIAC-IV computer. Final report.** Troubetzkoy, E.S.; Kalos, M.H.; Steinberg, H.A. (Mathematical Applications Group, Inc., Elmsford, N.Y. (USA)). Feb 1977. Contract DNA001-75-C-0025. 17p. (MAGI-m—7053). NTIS PC A02/MF A01.

A promising technique to parallelize Monte Carlo calculations has been developed previously and implemented in a versatile program to study radiation penetration through complex geometry. Attempts to make the program operational on the ILLIAC-IV computer were successful in a very limited sense, as only a few short runs ran to completion. The tentative conclusions drawn from this limited experience are not in contradiction with the validity of the technique parallelization.

43854 (PNL—2500(Pt.4), pp 2.1-2.37) **Fission.** Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Progress is reported in the areas of radiation physics; radiation dosimetry and radiation biophysics; microdosimetry of internal sources; dosimetry of internal emitters; real-time measurement of Pu in air at below-MPC levels; analytical techniques for measurement of ^{99}Tc in environmental samples; and radiation instrumentation--radiological chemistry. (GHT)

43855 **Optical observations of the dissociation of fast molecules in thin foils.** Berry, H.G.; Livingstone, A.E.; Gabrielse, G. (Argonne National Lab., Ill. (USA)). *Phys. Lett., A;* **64**: No. 1, 68-70(28 Nov 1977).

The authors have measured the Doppler broadening in Hsub(β) due to the Coulomb repulsion energy in the break-up of fast hydrogenic molecular ions passing through thin carbon foils. Asymmetries have been observed in the Doppler profile from the polarization 'wake'in the solid produced by the heavy component of the molecular ion.

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 43019

43856 (N—77-32867) **Improved analysis of electron penetration and numerical procedures for space radiation shielding.** Wilson, J.W.; Denn, F.M. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Sep 1977. 29p. (NASA-TN-D—8526; L—11690). NTIS PC A03/MF A01.

Electron penetration calculational techniques are reviewed with regard to their suitability for shield analysis in future space operations. Methods based on the transmission factors of Mar are discussed, and a correction term for low-energy electrons, which results in slightly conservative shield estimates, is derived. This modified Mar's method provides estimates of the dose for electrons that penetrate through shields of arbitrary elemental material with an atomic number greater than four. A complete computer algorithm is included.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 42859, 43261, 43332, 43345

43857 (ORNL/TM—6396) **FORM: perspective plotting code for one- and two-dimensional fluxes.** Ingersoll, D.T. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

FORM (Fluxes Over Region Map) is a perspective plotting code for displaying two-dimensional fluxes projected above the corresponding region boundary map. The code uses the extensive and versatile DISSPLA graphics package available at ORNL to provide a number of useful features including the plotting of R-theta fluxes. FORM uses FIDO input format and is designed to read flux tapes generated by the DOT 3.5 code. While providing a few unique features, FORM is intended as a limited alternative to the more extensive GOFRR plotting code.

43858 (UCID—17789) **Experimental determination of kerma factors at E/sub n/ ≃ 15 MeV.** Goldberg, E.; Slaughter, D.R.; Howell, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Apr 1978. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Experimental values for the kerma per unit fluence at the neutron energy, E/sub n/ = 15 MeV, have been determined for graphite, Mg, and Fe. Ion chambers of small size with walls of these materials were employed, and were filled with a variety of gases--N_2, CO_2, Ne, Ar, Kr, and Xe. A calibrated neutron source was employed, allowing a straightforward determination of the kerma per unit fluence.

43859 (UCID—17792) **DT fusion neutron irradiation of BNL—LASL superconductor wires, LASL YAG, Al_2O_3 and Spinel, LASL-IIT MgO, YAG, Al_2O_3 and Spinel, and NRL GeO_2 crystals, December 28, 1977.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 May 1978. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The DT fusion neutron irradiation of eleven BNL-LAST superconductor wires, six NRL GeO_2 crystals, two YAG, two Spinel and two Al_2O_3 crystals for LASL and four LASL high purity single crystals of MgO, YAG, Spinel and Al_2O_3 is described. The sample position, beam-on time, and neutron dose record are given. The maximum fluence on any sample was 1.51×10^{16} neutrons/cm^2.

RADIATION PROTECTION STANDARDS

REFER ALSO TO CITATION(S) 43744

DOSIMETRY

REFER ALSO TO CITATION(S) 43854

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 43239

43860 (LA—7035-MS) **Displacements and stresses about an arbitrarily loaded spheroidal inclusion.** Nashner, R.; Warren, N. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract EY-76-S-03-0034;W-7405-ENG-36. 38p. Dep. NTIS, PC A03/MF A01.

The calculation of theoretical elastic moduli of porous materials is presented. General and unrestricted equations for elastic moduli are presented. The theoretical expressions are written in terms of pore strains and porosities and are summarized. The remaining sections consist of summary descriptions of the computational methods developed for evaluating pore strains and elastic moduli. All of the expressions presented are based on the theoretical results of Edwards for stress concentrations and displacement fields around a single spheroidal inclusion in an infinite medium with an applied arbitrary external load. The solutions of Edwards are discussed. Outlines and examples of certain computer programs using these solutions are given.

43861 **Small-amplitude wave behavior in one-dimensional granular solids.** Nunziato, J.W. (Sandia Labs., Albuquerque, NM); Walsh, E.K. *J. Appl. Mech.;* **44**: No. 4, 559-564(Dec 1977).

The dynamic behavior of granular solids is considered in the context of a one-dimensional, linearized theory. Uniqueness of solutions for unbounded domains is established and two wave propagation problems are solved. In particular, the dispersion relations for small-amplitude sinusoidal progressive waves are obtained and the evolution of small-amplitude shock waves is exhibited.

43862 **Lattice dynamics of layered structures.** Wakabayashi, N. (Oak Ridge National Lab., TN). *Nuovo Cim., B;* **38**: No. 2, 256-262(11 Apr 1977).

From International conference on layered semiconductors and metals; Bari, Italy (6 Sep 1976).

The lattice dynamics of layered compounds is discussed on the basis of a set of two-dimensional lattices perturbed by weak interlayer interactions. Experimental observations which indicate quasi-two-dimensional character such as the temperature dependence of Debye temperatures and the Kohn anomalies are emphasized.

43863 **Stress in an elastic wedge or notch loaded by a localized internal source.** Sacks, R.A.; Robinson, J.E. (Argonne National Lab., IL). *J. Mater. Sci.;* **12**: 919-926(1977).

A study is presented of the stress inside a two-dimensional elastic solid which has a boundary surface angle and which is loaded by an internal point source of expansion. An exact analytic solution for the stress is obtained, for general surface angle and source position, and evaluated numerically for several representative cases of wedges and notches. The singular behaviour given by the leading terms near the angle vertex is found to be highly localized, and there is little or no stress enhancement near the source. For many combinations of boundary angle and source location, however, a local region of significant enhancement occurs on that part of the surface nearest the source. Implications of these results are discussed, with particular reference to surface steps.

43864 **Second Hugoniot relationship for solids.** Neal, T. (Los Alamos Scientic Lab., NM). *J. Phys. Chem. Solids;* **38**: 225-231(1977).

The term second Hugoniot is used to describe a locus of states directly attainable by shock compression beginning with an initial state that has itself been achieved by shock compression. For many materials the principal Hugoniot is linear in the shock velocity-particle velocity [U/sub s/ — u/sub p/] representation. A second Hugoniot for such materials is not linear in this representation, but the nonlinear effects can often be neglected if the compressions are not too great. These results are based on the Mie-Gruneisen equation of state and are more or less independent of the explicit functional dependence of the Gruneisen parameter. A criterion to evaluate the magnitude of nonlinear effects is posed and Mg and Pb are treated as examples. Calculated second Hugoniots are compared with experimental results for regular reflection in Mg, Pb and U. For these materials nonlinear effects are not important from a practical standpoint for final volumetric compressions to roughly two-thirds of the initial volume. Some future experimental work is also suggested.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 43251, 43332

THEORETICAL PHYSICS

RELATIVITY AND GRAVITATION

43865 **New H-space formalism.** Hansen, R.O. (California Univ., Berkeley (USA)); Ludvigsen, M. *Gen. Relativ. Gravitation;* **8**: No. 9, 761-786(Sep 1977).

The equations governing geometrical objects in H space are written in terms of operators adapted to families of left shear-free cross sections of complexified null infinity. The concept of H-conformal weight (HCW) is introduced, and a derivative operator which is closely connected with the co-variant derivative but which (unlike the covariant derivative) maps objects having well-defined HCW to other such objects, is defined. A function, derived from the Gaussian curvature of left shear-free slicings of null infinity and having a well-defined HCW, is shown to contain all the curvature information for H space.

FUSION ENERGY

REFER ALSO TO CITATION(S) 42665, 43120

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

43866 (N—78-11826) **Electron heating and anomalous transport in the initial stage of turbulent heating of a plasma.** Iguchi, H. (North Carolina State Univ., Raleigh (USA). Dept. of Soil Science). Aug 1977. 40p. (IPPJ—299). NTIS PC A03/MF A01.

Thompson scattering of ruby laser light was used to investigate the initial stage of turbulent plasma heating. In a low density discharge, an anomalously rapid electron heating was observed associated with the appearance of high frequency fluctuations which were considered to be current driven ion acoustic waves. The formulation of flat-top velocity distribution of the electrons just after the onset of the ion acoustic instability was interpreted as a quasilinear diffusion process in velocity space in the presence of ion acoustic waves. In a high density discharge, the skin current distribution was rapidly destroyed, while skin profile of the radial distribution of the electron temperature remained longer, indicating that the plasma current was redistributed without electron heat transfer across the magnetic field.

43867 (PPPL—1442) **Tokamak confinement.** Daughney, C.C. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). May 1978. Contract EY-76-C-02-3073. 34p. Dep. NTIS, PC A03/MF A01.

Empirical electron thermal conductivity and neoclassical ion thermal conductivity are used in a simple, zero dimensional analysis of the power balance in several tokamak experiments. The model gives reasonable understanding in all cases and emphasizes the effects of ion loss and radiation loss. The temperature dependence of the anomalous electron loss is evaluated.

43868 (UCRL—80656) **Plasma surface interactions in Q-enhanced mirror systems.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Mar 1978. 48p. (CONF-780431—5). Dep. NTIS, PC A03/MF A01.

From 3. conference on plasma interaction in controlled fusion devices; Abingdon, Oxfordshire, UK (3 Apr 1978).

Two approaches to enhancement of the Q (energy gain) factor of mirror systems are under study at Livermore. These include the Tandem Mirror and the Field Reversed Mirror. Both of these new ideas preserve features of conventional mirror systems as far as plasma-wall interactions are concerned. Specifically in both approaches field lines exit from the ends of the system and impinge on walls located at a distance from the confinement chamber. It is possible to predict some aspects of the plasma/surface interactions of TM and FRM systems from experience obtained in the Livermore 2XIIB experiment. In particular, as observed in 2XIIB, effective isolation of the plasma from thermal contact with the ends owing to the development of sheath-like regions is to be expected. Studies presently underway directed toward still further enhancing the decoupling of the plasma from the effects of plasma surface interactions at the walls will be discussed, with particular reference to the problem of minimizing the effects of refluxing secondary electrons produced by plasma impact on the end walls.

43869 (UWFDM—235) **IRF fueling of tandem mirror end plugs.** Kesner, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Mar 1978. Contract EY-S-02-2272. 19p. Dep. NTIS, PC A02/MF A01.

Ion heating by IRF may be useful for fueling as well as heating the high energy and density mirror end plugs required by a tandem mirror. Fueling may be accomplished by trapping the ions that are ejected from the central cell electrostatic well as they flow out through the end plugs. It is shown that for a reasonable level of RF power this trapping can be quite efficient. Furthermore for a fixed RF power level the trapping efficiency is seen to be adjustable by tuning the wave frequency.

43870 Heating and diagnostics by induced poloidal currents in a rotating plasma. Ohlsson, D. (Tekniska Hoegskolan, Stockholm (Sweden)). *Nucl. Instrum. Methods;* **147**: No. 2, 379-392(1 Dec 1977).

Resistive heating and conductivity measurements have been performed in a rotating plasma confined by a poloidal magnetic field which is generated by a ring-shaped internal conductor. The plasma heating is due to low frequency currents being induced along the magnetic field lines. Considerable power absorption is observed, as deduced from the corresponding large time shifts of the voltage-current characteristics determining the total plasma balance. Also from direct measurements the power input is found to be in the megawatt range. There are further indications of an increased plasma temperature, as obtained from spectroscopic measurements. Application of ohmic heating to a static plasma with magnetic shielding of the conductor supports thus looks promising. In addition, relative measurements have been made of the electric conductivity, in the case of induced low frequency currents having a negligible heating effect on the plasma. In order to make a comparison with theory, a nonstationary plasma fluid model is developed. The time and space dependent macroscopic fluid equations are solved using a numerical code. Qualitative agreement between theory and experiment is found under the assumption of classical temperature dependence of the electric conductivity.

43871 Interaction of a high intensity short pulse-width relativistic electron beam with plasma. Okamura, R.; Nakamura, Y.; Kawashima, N. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). *Plasma Phys.;* **19**: No. 11, 997-1016(Nov 1977).

An experiment is performed to study the interaction of a high intensity relativistic electron beam with plasma by using a short pulse-width electron beam source. Febetron (500 keV, 2 kA, 3 ns). The beam is injected axially into a magnetized plasma column with its density nsub(p) = 4 x 10^{11} - 1 x 10^{13} cm^{-3}. The beam current is observed to be completely neutralized by a 'reverse current' when the plasma density is sufficiently high (nsub(p) approximately $>$ 2 x 10^{12} cm^{-3}). In a low density region (nsub(p) approximately $<$ 2 x 10^{12} cm^{-3}), decay of the reverse current appears, which can be explained by enhanced collisions due to plasma instabilities. Though the pulse-width is so short as 3 ns, the beam energy is efficiently transferred to plasma and plasma is heated. The increment of plasma energy density is up to 1 x 10^{18} eV cm^{-3}. Dependence of plasma energy increment upon the initial plasma density and the beam current are studied. As a result of the beam-plasma interaction, strong microwave emissions are observed at frequencies near electron cyclotron harmonics (f = n.fsub(ce), n = 2,3,...) that last long after the termination of the beam, and the fundamental emissions are very weak. A possible explanation is presented to attribute the microwave emissions to electrostatic cyclotron harmonic wave instabilities excited in non-Maxwellian plasma heated by the electron beam and trapped in the magnetic field.

43872 Resistive effects on Alfven wave heating. Kappraff, J.M. (New Jersey Institute of Technology, Newark (USA)); Tataronis, J.A. *J. Plasma Phys.;* **18**: No. , p. 209-226(Oct 1977).

The effects of resistive dissipation on energy absorption by spatially localized Alfven waves which form a part of the continuous spectrum of ideal magnetohydrodynamics (MHD) are considered. It is demonstrated that the strong absorption rate found in ideal MHD is unaltered for plasma resistivities of the order found in tokamaks, thus implying the possibility of effective heating of these machines by Alfven waves.

43873 Lower-hybrid plasma heating in a tokamak. Musher, S.L.; Rubenchik, A.M.; Sturman, B.I. *Pis'ma Zh. Eksp. Teor. Fiz.;* **25**: No. 8, 358-361(20 Apr 1977). (In Russian).

43874 Parametric instabilities in laser heating of magnetically confined plasmas. Karttunen, S.J.; Salomaa, R.R.E. (Technical Research Centre of Finland, Otaniemi. Nuclear Engineering Lab.). *Phys. Scr.;* **16**: No. 3, . 129-136(1977).

This paper discusses the generation of parametric instabilities in laser heating of plasmas confined in a linear magnetic device. The nonlinearities are taken into account by the inclusion of a ponderomotive force. A generalized dielectric tensor and the corresponding dispersion relation are derived which enables one to determine the instability thresholds and linearized growth rates. The cases where the parametrically excited low frequency wave propagates either parallel or perpendicular to the magnetic field are analyzed in detail. Propagation in an oblique direction is briefly described. As regards the laser heating schemes, the low frequency filamentation and the stimulated Brillouin scattering seem to pose a possible difficulty. Fortunately, several of the potential instabilities cannot be excited in the configuration considered.

43875 Ohmic plasma heating by magnetic field-aligned currents in an internal ring configuration. Ohlsson, D. (Royal Institute of Technology, Stockholm, Sweden). *Phys. Scr.;* **15**: No. 5, . 325-330(1977).

This investigation concerns heating of a plasma being impermeable to neutral gas and situated in a magnetic bottle where the confining field is generated mainly by the current in a supported internal ring. The losses to the ring supports are considered in terms of a single-particle model. The reduction of these losses due to magnetic support shielding is investigated. Further, all transport processes are assumed to be of classical origin, but anomalous effects can be simulated by introducing certain numerical factors. The possibility of local concentration of the induced heating current resulting in a thermal instability is also investigated. Particular interest is focussed on the relation between the heat loss to the supports and the threshold condition for this instability. The results of the present investigation have been derived from numerical solutions of a set of nonstationary macroscopic fluid equations.

43876 Plasma heating on the Langmuir collapse. Gorev, V.V.; Kingsep, A.S.; Yan'kov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Zh. Eksp. Teor. Fiz.;* **70**: No. 3, 921-928(Mar 1976). (In Russian).

The three-dimensional problem of the formation of fast electrons in a plasma on the Langmuir collapse is solved. It is shown that the problem has a self-similar solution according to which virtually all energy of the external source of the Langmuir oscillations is concentrated in a small group of resonance particles which decreases with time.

PLASMA DIAGNOSTICS

43877 (TRITA-EPP—77-24) **Electron temperature measurements in lowdensity plasmas by helium spectroscopy.** Brenning, N. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Sep 1977. 25p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This method to use relative intensities of singlet and triplet lines of neutral helium to measure electron temperature in low-density plasmas is examined. Calculations from measured and theoretical data about transitions in neutral helium are carried out and compared to experimental results. It is found that relative intensities of singlet and triplet lines from neutral helium only can be used for TE determination in low-density, short-duration plasmas. The most important limiting processes are excitation from the metastable 2^3S level and excitation transfer in collisions between electrons and excited helium atoms. An evaluation method is suggested, which minimizes the effect of these processes.

43878 (TRITA-PFU—77-05) **Electron temperature measurements in a dense plasma using a self-swept double probe.** Drake, J.R. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Sep 1977. 8p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A complete floating double probe current-voltage characteristic and an estimate of the electron temperature can be generated in one shot in dense plasmas by disharging a capacitor through the plasma and monitoring the probe current and bias voltage.(author).

43879 Use of optical filters for Tokamak plasma spectroscopy. Morton, A.H.; Srinivasacharya, K.G. (Australian National Univ., Canberra. Dept. of Engineering Physics). *J. Phys., E (London);* **11**: No. 2, 131-134(Feb 1978).

A description is given of a method for using narrow-bandpass optical interference filters to make a number of simultaneous chord observations of plasma radiation from a Tokamak. Employed with the Canberra Tokamak LT-3 the method has been applied to provide measurements of O III, O IV and O V impurity radiation from a hydrogen plasma.

43880 X-ray spectroscopy of multiply-charged ions from laser plasmas. Boiko, V.A.; Faenov, A.Ya.; Pikuz, S.A. (AN SSSR, Moscow. Fizicheskij Inst.). *J. Quant. Spectrosc. Radiat. Transfer;* **19**: No. 1, 11-50(Jan 1978).

Original results are reported on the observation and identification of spectra of multiply-charged ions in the range of lambda approximately 1.5 to 15 A, which corresponds to transitions with a change of principal quantum number n. The main part of the review

consists of tables with about a thousand spectral lines, which have been mainly observed in laser-plasma radiation, as well as in the solar corona and other laboratory sources at an electron temperature Tsub(e) approximately 10^7 °K. The accuracy for the wavelengths (Δlambda) is the following: Δlambda is equal to approximately 0.0005 A for lambda approximately 2.5 A and it is equal to approximately 0.003 A for lambda approximately 15 A. The spectral lines are considered for the following transitions: 1-n type for [H]-like ions (Z = 11 to 16) and [He]-like ions (Z = 11 to 26; 2-n type for [Li]-like ions (Z = 19 to 26), [Be]-like ions (Z = 22 to 34) and [Ne]-like ions (Z = 26 to 42); 3-n type [Co]- and [Ni]-like ions (Z = 73). The line-list contains about four hundred wavelengths for multiply-charged iron L-ions (Fe(XVII) to Fe(XXIV)) and is presented with identification of some of the transitions. The wavelengths and intensities of satellites of the [H]-like ions and [He]-like ions, which are caused by transitions from the doubly-excited autoionization states 2l2l′ and 1s2l2l′ of [He]-like ions (Z = 11 to 16) and [Li]-like ions (Z = 11 to 26), respectively, are also considered.

43881 Cyclotron radiation of tokamak plasmas. Rutgers, W.R. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). *Ned. Tijdschr. Natuurkd.;* **43**: 158-162(Dec 1977). (In Dutch).

A description of the Princeton Large Torus is given and some experiments are done with it on behalf of plasma diagnostics. Cyclotron radiation of tokamak plasmas is elucidated with the aid of calculations and experiments descriptions. Experimental values are compared with those published for other tokamak devices like Alcator, TFR, CLEO, DITE and TORTUR.

43882 Stark broadening of isolated lines of F(II) and Cl(III) by plasmas. Hey, J.D. (Cape Town Univ. (South Africa). Dept. of Physics). *J. Quant. Spectrosc. Radiat. Transfer;* **18**: No. 6, 649-655(Dec 1977).

Recent measurements of Stark widths of isolated lines emitted by singly-ionized fluorine atoms and doubly-ionized chlorine atoms are compared with the corresponding values calculated by the semi-empirical impact approximation of Griem. A discussion is given of some of the difficulties which arise particularly when this method is applied to lines from multiply charged ions. On the basis of these comparisons, some new values are proposed for the threshold Gaunt factors of the ions under consideration, and these are compared with values deduced earlier for a number of other ions. Some systematic trends are observed.

43883 Interferometer for measuring Doppler profiles of ionized helium lines from hot plasmas. Matsuda, N. (Ehime Univ., Matsuyama (Japan). Faculty of Engineering). *Ehime Daigaku Kiyo, Dai-3-Bu, Kogaku;* **8**: No. 4, 557-566(Mar 1977). (In Japanese).

The method of measurement with the previously developed interferometer for measuring the temperature of helium plasma ions was reexamined, and particularly a case using a nonmetallic multilayer reflection film was studied theoretically and experimentally. The doppler width of Hell, 4686 A wave length, was observed. Fabry-Perot's interferometer, especially the type with fixed plane-parallel plates, was employed because of the simple construction and inexpensiveness. This interferometer can be used effectively even when the light quantity of plasma is small, if the nonmetallic multilayer etalon with less absorption is employed. Consideration was given to the arrangement of thinner spacer (0.5 mm) than conventional one, and to make the monochromator brighter. The interferometer with 10 cm diameter plates was used. Its spectral range was 2.2 A and the instrument width at a half intensity was 0.074 A. Each photomultiplier detector looks at successively larger angle, such that the wave length separation between detectors was 0.1 A. The change in interferometer air pressure corresponds to shifting the peak of line from one channel to the next. As a result of measuring the thickness of six spacers of etalon, the error was small. In addition, two reflection mirrors were held in parallel by using a spring adjusting mechanism. It was confirmed that adsorption was less by measuring the transmissivity and reflectivity of the nonmetallic multilayer film.

43884 Density-dependent lines of one- and two-electron ions in diagnostics of laboratory plasma. I. The rates of collision relaxation of excited levels. Shevelko, V.P.; Skobelev, I.Yu.; Vinogradov, A.V. (Lebedev Physical Institute, Academy of Sciences of the USSR, Moscow, USSR). *Phys. Scr.;* **16**: No. 3, . 123-128(1977).

Plasma devices with inertial plasma confinement such as laser produced plasmas, exploding wires, plasma focus, etc., which have been rapidly developed during recent years., appear to be very intensive sources of spectral line radiation in far UV and X-ray regions. Analysis of this radiation provides a good tool for plasma diagnostics with very high electron densities up to $10^{22}cm^{-3}$. In this work, consisting of two parts, the authors consider the mechanism of the formation of spectral lines in hot and dense plasma. The key point for density diagnostics is the fact that for some ion levels the rate of collisional relaxation has the same order of magnitude as the radiative decay. Thus the intensities of spectral lines arising from these levels show a strong dependence on electron density which makes diagnostics possible. In this paper, emphasis is laid on the calculation of rates of transition between close ion levels induced by electron or ion impact, which usually gives the main contribution to the collisional relaxation constants. The influence of plasma polarization effects on the collision frequency in a dense plasma is also considered.

43885 Microwave resonant cavity method for the investigation of the corona discharge. Sipocz, T.; Lukac, P.; Veis, S. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). *Acta Phys. Slovaca;* **27**: No. 2, 127-133(1977).

A specially adjusted and modified microwave cavity method was applied in determining the electron density in the corona discharge at atmospheric pressure in air and in argon. The discharge was sustained between the inner and outer cylinders of an open coaxial cavity which had been specially developed for the investigation of the corona. The electromagnetic waves of TM_{011} mode and 3 cm resp. 10 cm wavelength bands were used for measurements. The modified method made it possible to measure electron densities in the corona about 4 orders lower as against the waveguide method. The shift observed in the resonance frequency of the cavity showed that the mean electron density in the corona discharge is less than $10^8\,cm^{-3}$.

43886 Microwave diagnostics of pulsed plasma. Kalivoda, L.; Rosenkranz, J. *Acta Polytech. (Prague), IV;* No. 3, 41-46(1976). (In Czech).

From 3. scientific conference of Czech Technical University; Prague, Czechoslovakia (2 - 4 Nov 1975).

Three block diagrams of microwave measurement systems for the velocity of plasma clusters are given. The first equipment uses a wavelength of 3 cm and measures the mean velocity, the second measures the instantaneous velocity and the third measures the mean velocity and electron concentration. The results of measurements on a rail accelerator of plasma clusters are mentioned.

PLASMA KINETICS - GENERAL

43887 (N—78-10882) **Current sustaining by rf travelling field in a collisional toroidal plasma.** Fukuda, M.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1977. 22p. (IPPJ—292). NTIS PC A02/MF A01.

Phase velocity and filling gas pressure or electron collision frequency were parameters used in an investigation of current generation by the RF traveling field in a collisional toroidal plasma. On the basis of the fluid model used, an electromotive force, which acts as a current driving electric field, is introduced. In a low magnetic field, the current is proportional to the plasma conductivity. The electromotive force is proportional to the absorbed RF power and inversely proportional to the plasma density and the phase velocity of the traveling field.

43888 Bringing fusion electric power closer. Kintner, E. (Energy Research and Development Administration, Washington, DC). *Horizons;* **13**: No. 2, 2-7(1977).

A review of the controlled fusion research program is given. The tokamak research program is described. Beam injection heating, control systems, and the safety of fusion reactors are topics that are also discussed. (MOW)

PLASMA KINETICS - EXPERIMENTAL

43889 (ZAED-tr—77/3) **Method for the determination of the spectral composition of powerful energy-rich deuteron bundles generated in the plasma focus.** Philippow, N.W.; Philippowa, T.I. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1977. 13p. (In German). (IAE—2827). Dep. NTIS (US Sales Only), PC A02/MF A01.

A method is presented which allows a quantitative determination of the spectral composition of a high power deuterium bunch produced in noncylindrical Z-pinch type systems when the plasma shell is increased. The bunch moves in the normal direction, i.e. from the anode to the region behind the cathodes. The method is based on the principle of a time-of-flight spectrometer, where the neutron scintillation detector signal is processed appropriately and displayed on a scope. The neutrons are produced by the $^{12}C(d,n)^{13}N$-reaction in the carbon target when hit by a deuterium bunch. These investigations have been performed in parallel with the method based on a comparison of carbon- and aluminium target activities. This method has been used in the past by R. Gallickson and G. Salin in the Livermore Laboratory for the same purpose but has now untergone some improvements.

43890 Measurements of the ionisation rates of lithium-like ions. Kaellne, E.; Jones, L.A. (Los Alamos Scientific Lab., N.Mex. (USA)). *J. Phys., B (London);* **10**: No. 18, 3637-3648(21 Dec 1977).

The ionisation rates of lithium-like nitrogen (N V) and oxygen (O VI) were measured using a 60 kJ theta pinch as a plasma light source (Tsub(e) = 80 to 150 eV, Nsub(e) approximately 1 to 5 x 10^{16} cm^{-3}). The time evolutions of strong VUV lines were observed with a 2.2 m grazing-incidence monochromator. Two different plasmas were used (2.5 mT N_2 and 20 mT (He + 1% O_2)) and diagnosed with 90° Thomson scattering (Tsub(e)) and holographic interferometry (Nsub(e)). The plasma was modelled using the coupled rate equations with the semiempirical formula of Kunze for the ionisation rates. The measured ionisation rates for the lithium-like ions were found to be consistent with those calculated by Kunze's semiempirical formula to within 10%. Corrections were made in the present model for end losses, temperature dependence of the excitation rates, radial electron density and temperature distributions, lowering of the ionisation limit due to collisions, and overlap of the 2s and 2p levels in the ground-state population.

43891 Experimental check of the electron distribution function in a current carrying plasma. Alladio, F.; Martone, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)). *Phys. Lett., A;* **64**: No. 2, 199-201(12 Dec 1977).

The local current density obtained by means of Thomson scattering measurements (with a component of the scattering vector k along the current direction) has been compared with the local current density obtained by means of magnetic field measurements made using a magnetic probe inserted in the plasma. A better agreement has been found between the two kinds of measurements when the scattered signals have been treated on the assumption of the Spitzer-Haerm electron distribution function than on the assumption of the displaced Maxwellian one for the current carrying plasma.

43892 Observation of classical diffusion in the presence of large amplitude density fluctuations. Navratil, G.A.; Post, R.S. (Wisconsin Univ., Madison (USA)). *Phys. Lett., A;* **64**: No. 2, 223-225(12 Dec 1977).

Density fluctuations delta n/n < approximately 20%, were observed to have no effect on the classical diffusion of a collisional helium plasma across a poloidal octupole field with an additional weak toroidal field. The implication of these results on tokamak scattering experiments is discussed.

43893 Suprathermal microwave emission from the plasma focus. Herziger, G.; Krompholz, H.; Michel, L.; Schoenbach, K. (Technische Hochschule Darmstadt (Germany, F.R.)). *Phys. Lett., A;* **64**: No. 1, 51-52(28 Nov 1977).

Temporal, spectral and angular distribution of suprathermal microwave radiation, indicating on the excitation of microinstabilities, has been investigated at the plasma focus.

43894 Plasma focus current in the compression phase. Oppenlaender, T.; Pross, G.; Decker, G.; Trunk, M. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Plasmaforschung). *Plasma Phys.;* **19**: No. 11, 1075-1083(Nov 1977).

The plasma focus current is measured using small magnetic probes, which are decoupled from the ground potential. It is found, that only some - pressure dependent - fraction of the total current in the device flows at the focus region. The correlation between this current and the neutron yield can be described as Y approximately I^4. The occurrence of m = 0 instabilities in the focus plasma appears in the probe signal and is also correlated to the neutron yield. A comparison between MHD-calculations and the observed field structures is presented.

43895 Observation of fast ions in laser-produced plasma. Zakharenkov, Yu.A.; Krokhin, O.N.; Sklizkov, G.V.; Shikanov, A.S. (AN SSSR, Moscow. Fizicheskij Inst.). *Pis'ma Zh. Eksp. Teor. Fiz.;* **25**: No. 9, 415-418(5 May 1977). (In Russian).

43896 Determination of spatial distribution of plasma density pulsations on modulation of a reflected wave. Skibenko, A.I.; Fomin, I.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Ukr. Fiz. Zh. (Russ. Ed.);* **22**: No. 5, 808-811(May 1977). (In Russian).

A method is described for determination of a density pulsation level in the local plasma layer by means of microwave reflection from the waveguide end placed into plasma. The results of microwave measurements at lambda=8 mm in pulsed PIG discharge are in a good agreement with pulsation values obtained by the double Langmuir probe.

43897 Some recent results in high pressure arc discharge research. Bauder, U.H. (Technische Univ. Muenchen (Germany, F.R.). Elektrophysikalisches Inst.). *J. Phys. (Paris), Colloq.;* No. 3, C.135-C.140(1977).

From National congress on plasma physics; Paris, France (6 - 10 Dec 1976).

Only a few selected topics presently under active study are presented which touch on the fields of plasma diagnostics and transport property work. Cascade arcs appear to be an excellent tool for the development of plasma diagnostical techniques per se, as well as for the generation of atomic data (continuous radiation from Ar and H arcs are given). The electrical conductivity, thermal conductivity, radiation source strength, and viscosity are among the properties which can be determined as functions of temperature and pressure from measurement on wall stabilized cascade arcs (nitrogen, air).

PLASMA KINETICS - THEORETICAL

43898 (HCP/T2865—01) **Assessment of contemporary mathematical methods for magnetic fusion research.** Treve, Y.M. (Treve (Yvain M.), Santa Barbara, Calif. (USA)). Mar 1978. Contract EA-77-X-01-2865. 110p. Dep. NTIS, PC A06/MF A01.

The mathematical techniques reviewed have been selected on the basis of their relevance to at least four outstanding theoretical problems of magnetic fusion research, namely: (a) ion heating; (b) particle-wave interactions; (c) stability of magnetic surfaces in real tokamaks; and (d) strong plasma turbulence. These problems have a common feature: they all involve chaotic motions in spite of the perfectly deterministic nature of the mathematical models used for their description. In the first section devoted to Hamiltonian systems we briefly review the essentials of the Hamilton-Jacobi theory and discuss the Kolmogorov-Arnold-Moser theorem and its implications. In section 2 we review the difficulties of the problem of turbulence and present the Ruelle-Takens picture. An example of a dynamical system with a strange attractor is constructed and the Hopf bifurcation theory is discussed. Finally we review the properties of the Lorenz model for the convective instability of an atmospheric layer which is known to have a strange attractor for sufficiently high Rayleigh numbers.

43899 (PPPL—1435) **Program generator for the Incomplete Cholesky Conjugate Gradient (ICCG) method.** Kuo-Petravic, G.; Petravic, M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Apr 1978. Contract EY-76-C-02-3073. 32p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

The Incomplete Cholesky Conjugate Gradient (ICCG) method has been found very effective for the solution of sparse systems of linear equations. Its implementation on a computer, however, requires a considerable amount of careful coding to achieve good machine efficiency. Furthermore, the resulting code is necessarily inflexible and cannot be easily adapted to different problems. We present in this paper a code generator GENIC which, given a small amount of information concerning the sparsity pattern and size of the system of equations, generates a solver package. This package, called SOLIC, is tailor made for a particular problem and can be easily incorporated into any user program.

43900 Kolmogorov turbulent spectrum in the direct interaction model. Kuznetsov, E.A.; L'vov, V.S. (AN SSSR, Novosibirsk. Inst. Avtomatiki i Ehlektrometrii). *Phys. Lett., A;* **64**: No. 2, 157-158(12 Dec 1977).

In the Direct Interaction Approximation equations have been formulated, which completely take into account the transfer effect and have a precise solution in the form of the Kolmogorov spectrum.

43901 Nonlinear axisymmetric equilibria in the magnetohydrodynamic approximation. Woolley, M.L. (Sussex Univ., Brighton (UK)). *J. Plasma Phys.;* **18**: No. 3, 537-550(Dec 1977).

The second order elliptic differential equation which describes the static equilibrium of an axisymmetric ideally conducting plasma toroid, in the magnetohydrodynamic approximation, may be transformed into an equivalent equation which admits at least one class of exact analytic solutions for which the original equation is essentially nonlinear. Necessary and sufficient conditions are given for the existence of systems in this category having closed toroidal flux surfaces and a result is proved which gives some insight into the mathematics by which the spatial variation of the hydrodynamic pressure can be represented by families of nested closed curves.

43902 Anisotropic temperature relaxation of plasmas in an external magnetic field. Hassan, M.H.A. (International Centre for Theoretical Physics, Trieste (Italy)). *Plasma Phys.;* **19**: No. 11, 1043-1050(Nov 1977).

The magnetized kinetic equation derived in an earlier paper (Hassan and Watson, 1977) is used to study the problem of relaxation of anisotropic electron and ion temperatures in a magnetized plasma. In the case of anisotropic electron temperature relaxation, it is shown that for small anisotropies the exchange of energy within the electrons between the components parallel and perpendicular to the

magnetic field direction determine the relaxation rate. For anisotropic ion temperature relaxation it is shown that the essential mechanism for relaxation is provided by energy transfer between ions and electrons, and that the expression for the relaxation rate perpendicular to the magnetic field contains a significant term proportional to ln eta$_0$ ln (msub(e)/msub(i)) (where eta$_0$ = Ωsub(e)/ksub(D)Vsub(e perpendicular to)), in addition to the term proportional to the Coulomb logarithm.

43903 Coherent state approach to the Vlasov equation. Ghosh, G.; Dutta-Roy, B. (Saha Inst. of Nuclear Physics, Calcutta (India)); Bhaumik, D. *Plasma Phys.;* **19**: No. 11, 1051-1054(Nov 1977).

The Vlasov equation is approached from the coherent state basis. This treatment has the virtue of keeping the classical correspondence explicit at various stages. As an illustration of this approach the classical expression for the longitudinal dielectric constant of a uniform magnetized plasma is obtained. While for gaseous plasmas quantum effects are negligible and classical physics is adequate, the present approach, constituting a quantal approach and passage to the classical limit, is motivated by advantages which accrue in more difficult problems involving non-linear interactions.

43904 Non-adiabatic effects in charged particle motion near a neutral line. Rusbridge, M.G. (Manchester Univ. Inst. of Science and Technology (UK)). *Plasma Phys.;* **19**: No. 11, 1087-1091(Nov 1977).

Particle motion in general and the change in magnetic moment in particular are strongly dependent on phase in the gyration of the particle about the magnetic field. The change in magnetic moment can be sufficient to trap the particle temporarily in the region of low field surrounding the neutral line. Estimates of the probability of trapping depend on a knowledge of the maximum changes in magnetic moment that can occur.

43905 Non-uniqueness of ideal MHD equilibria, with implications for tokamak calculations. Field, J.J.; Papaloizou, J.C.B. (UKAEA Research Group, Abingdon. Culham Lab.). *J. Plasma Phys.;* **18**: No. , p. 347-361(Oct 1977).

Non-linear ideal MHD equilibria in axisymmetric systems are examined, both in diffuse and free boundary cases. Attention is restricted to the situation in present low-β tokamak experiments, in which there are no current reversals. Both general qualitative results on the uniqueness and bifurcation of solutions are provided and exact solutions of several problems in a circular cylinder are given, exhibiting bifurcation phenomena. In particular sufficient conditions for bifurcation behaviour are conjectured, for both diffuse and free boundary equilibria.

43906 Magnetic field aligned electric fields in an adiabatic plasma. Hruska, A. (National Research Council of Canada, Ottawa, Ontario. Astrophysics Branch). *J. Plasma Phys.;* **18**: No. , p. 243-248(Oct 1977).

A stationary collisionless and neutral plasma flowing along magnetic lines of force (B-lines) is considered and the variation of electric potential along the B-lines is described. A steep magnetic field aligned gradient of electric potential is generated at a certain location whenever plasma moves along the lines of force.

43907 Discontinuous transitions in a current-carrying plasma. Lee, H.J. (California Univ., San Diego, La Jolla (USA). Dept. of Applied Physics and Information Science); McKenzie, J.F.; Axford, W.I. (Max-Planck-Institut fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.)). *Astrophys. Space Sci.;* **51**: No. 1, 3-32(Sep 1977).

The properties of 'discontinuous' transitions in a current-carrying plasma are analyzed by formulating the problem in terms of the two-fluid (i.e., electrons and ions) equations. The jump conditions, which connect states on either side of a discontinuity, are derived and it is shown that these are similar to the ordinary gas-dynamic Rankine-Hugoniot conditions except that there are extra terms which represent an enhanced mass flux in the momentum equation, and an additional heat flux in the energy equation, both of which arise from the existence of a current flow through the discontinuity.

43908 Magnetic hydrodynamics of a collisionless plasma. Zhdanov, S.K.; Trubnikov, B.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Zh. Eksp. Teor. Fiz.;* **72**: No. 2, 488-498(Feb 1977). (In Russian).

The results of investigations to specify the anisotropic two-fluid magnetohydrodynamics equation system for a collisionless plasma in an inhomogeneous magnetic field B are presented. The equation system accounting for $1/B^2$ order terms is derived by expansion of the kinetic euqation. In particular the magnetic viscosity tensor and heat flow equations are obtained. The results are noted to coincide with ones obtained elsewhere at the first order accuracy.

43909 Evolution in space and time of two interacting intensities. Wilhelmsson, H. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Scr.;* **16**: No. 3, . 156-160(1977).

The basic nonlinear coupled equations describing the interaction between two intensities (or two populations) are discussed. Analytical solutions are deduced for the evolution in space and time of initially given perturbations of the equilibrium intensities.

43910 Particle acceleration on breaking of the constrictions of a Z-pinch and in the plasma focus. Trubnikov, B.A.; Zhdanov, S.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Zh. Eksp. Teor. Fiz.;* **70**: No. 1, 92-103(Jan 1976). (In Russian).

It is demonstrated that during the development of instabilities of the constriction type on the plasma filament of a discharge the E>B condition may be satisfied (E- an electric field B- magnetic field). In this case the particle motion ceases to be of the drift type, and "direct" particle acceleration in an electric field Esub(z) becomes possible.

PLASMA PRODUCTION

43911 (AD-A—047818) Cross field thermal transport due to ion acoustic waves in magnetized laser plasmas. Interim report. Manheimer, W.M.; Max, C.E.; Thomson, J. (Naval Research Lab., Washington, D.C. (USA)). Sep 1977. Contract E(49-20)-1006. 24p. (NRL-MR—3593). NTIS PC A02/MF A01.

It is shown that cross field temperature gradients can drive ion acoustic waves unstable in a laser produced plasma. The principle effect of the instability is an enhancement of the cross field thermal conductivity. It is shown how this effect can be modeled in laser fusion hydrocodes. (Author)

43912 Highly directional expansion of laser-produced plasmas. Doschek, G.A.; Feldman, U.; Burkhalter, P.G.; Finn, T. (Naval Research Lab., Washington, D.C. (USA)); Feibelman, W.A. *J. Phys., B (London);* **10**: No. 18, L745-L748(21 Dec 1977).

The expansion of plasmas produced by focusing a CO_2 laser pulse onto solid planar targets is discussed. The plasmas are studied using an extreme ultraviolet spectroheliograph. With titanium and iron targets the plasma blow-off observed in transitions within highly ionised species (e.g. Fe XVI) occurs parallel to the target normal. The plasma is tightly confined to narrow cylindrical structures, about 0.7 mm in diameter, and is observed as far as 1 cm from the target surface. The electron density is about 2.8×10^{18} cm^{-3} at a distance of 0.7 mm from the target surface and decreases to approximately 6.5×10^{17} cm^{-3} at a distance of 2.9 mm from the surface.

43913 Interpretation of enhanced laser-plasma backscattering due to prepulse radiation. Anderson, D. (UKAEA Research Group, Abingdon. Culham Lab.); Wilhelmsson, H. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Lett., A;* **64**: No. 1, 47-48(28 Nov 1977).

Noise generated by a laser prepulse in laser target interaction experiments is suggested and analysed as a possible explanation of the recently observed enhanced laser back-scattering.

43914 Effect of a strong magnetic field on a laser plasma from a solid target produced in a gaseous atmosphere. Kaitmazov, S.D.; Shklovskii, E.I. (AN SSSR, Moscow. Fizicheskij Inst.). *Zh. Eksp. Teor. Fiz.;* **71**: No. 6, 2091-2097(Dec 1976). (In Russian).

The effect of a magnetic field on the dynamics of development of a laser plasma from a target is investigated at various pressures of the ambient gas using streak-camera. The velocity of laser-supported detonation wave in a magnetic field H=170 kOe is higher than is in the case of H=O. The presence of the magnetic field results in a more efficient generation of X-rays by the laser plasma in the focus region. A long-lived hot plasma which cannot expand radially is found to be formed on the optical axis in the magnetic field. It is demonstrated that it should be possible, in principle, to separate plasma bulks with different parameters by means of a magnetic field.

43915 Postcritical-density stationary plasma on highly absorbant (metallic) targets in vacuum under TEA-CO_2 laser radiation. Apostol, I.D.; Grigoriu, C.; Morjan, I.; Mihailescu, I.N. (Institutul de Fizica Atomica, Bucharest (Romania)); Batanov, V.A.; Fedorov, V.B.; Prokhorov, A.M. (Lebedev Institute, Moskow (USSR)). *Rev. Roum. Phys.;* **21**: No. 4, 372-378(1976).

The results of the studies of highly absorbant (metallic) targets evaporation under TEA-CO_2 laser radiation, for incident intensities I, of (10^7/19^9) W.cm^{-2}, are for the first time reported. The recoil impulse acting backward on the target and the amount of material removed from the target during a laser pulse were measured for every irradiated target. We got experimental values in concordance with the data given in (3), which were obtained with a neodymium glass laser (lambda = 1.06μ), for I = (10^6 - 10^7) W.cm^{-2}. A plasma with a density higher than the critical model is proposed in view of interpreting these results.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 43871

43916 (AD-A—047184) **The effects of cross-sectional elongation on trapped electron modes. Interim report.** Chu, K.R.; Ott, E.; Manheimer, W.M. (Naval Research Lab., Washington, D.C. (USA)). Sep 1977. 22p. (NRL-MR—3615). NTIS PC A02/MF A01.

The dispersion relation for the trapped electron mode in noncircular cross-section tokamaks is formulated and evaluated. It is shown that modest reductions in the growth rate result from cross-sectional elongation. (Author)

43917 (EUR-CEA-FC—910) **Drift modes energized by trapped electrons in the case of large transverse azimuthal wave numbers.** Koechlin, F.; Samain, A. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1977. 39p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The drift modes energized by trapped electrons are discussed in the case where the azimuthal transverse wave number is of the order of the inverse ion thermal Larmor radius. For the usual values of the shear, the parallel wave number is then larger than 1/qR in the major part of the radial interval where the mode escapes ion Landau damping. The time during which the trapped electrons remain coherent with the mode is reduced and the Kadomtsev dissipative mechanism is less efficient. The critical shear for the onset of the instability and the induced electron energy transport coefficient at a given level of the density fluctuation are estimated.

43918 (IAE—2584) **Some problems in the theory of tokamak microinstabilities.** Lominadze, D.G.; Mikhaylovskii, A.B.; Tehng, U.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. 9p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Results are analyzed recent (1966-1975) investigations on the theory of microinstabilities in tokamaks. Papers are dealing with electrostatic instabilities on trapped particles, nonpotential instabilities on trapped electrons excited by fast electrons of Alfven waves, excitation of fast magnetosound waves by α-particles, etc. The necessity is shown to take into account the real toroidal geometry of a system. It is also shown that instead of the "classical" one-component tokamak the "two-component" tokamak is mainly discussed containing a group of fast ions whose total energy is comparable with the rest plasma energy. It is inferred that only after the development of the theories of the linear and nonlinear stages of instabilities the actual role of microinstabilities in the problem of tokamak-reactors will be clearly established.

43919 (N—78-11829) **Current driven instability in both self-induced and external magnetic shear field.** Inoue, S.; Itoh, K.; Yoshikawa, S. (North Carolina State Univ., Raleigh (USA). Dept. of Soil Science). Aug 1977. 14p. (IPPJ—302). NTIS PC A02/MF A01.

The current-driven universal drift instability in a self-consistent magnetic shear field was analyzed. A novel and simple method to determine the eigen value of the model was developed. It is found that even in a fairly strong shear residual, modes remain unstable in the presence of the parallel current. The confinement scaling law for high field Tokamaks was obtained.

43920 (N—78-11830) **Shear stabilization of collisional drift instability.** Inoue, S.; Itoh, K.; Yoshikawa, S. (North Carolina State Univ., Raleigh (USA). Dept. of Soil Science). Aug 1977. 14p. (IPPJ—303). NTIS PC A02/MF A01.

Using the normal mode expansion method, the collisional drift waves of the slab plasma in the sheared magnetic field were investigated. In the strong shear parameter regime, the growth rate is found to be proportional to the square root of the electron collision frequency/omega sub *. The diffusion coefficient is also estimated and the density limitation of the high density Tokamak is shown.

43921 (PPPL—1434) **Parametric excitation of drift waves with the pump near the ion cyclotron frequency in a two-ion-species plasma.** Ono, M.; Porkolab, M.; Chang, R.P.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Apr 1978. Contract EY-76-C-02-3073. 11p. Dep. NTIS, PC A02/MF A01.

Parametric excitation of drift waves in a multi-ion species plasma is observed in a range of pump frequencies, $\omega/\text{sub pi}//\Omega/\text{sub i}/$ much greater than $\omega/\text{sub o}//\Omega/\text{sub i}/$ approximately equal to 1.3 to 1.6 and the ion concentration ratio, N(He):N(Ne) = 8:2 to 3:7. The dispersion relation and the excitation mechanism are verified.

43922 (PPPL—1446) **Theory of universal eigenmodes in a sheared magnetic field.** Chen, L.; Guzdar, P.N.; White, R.B.; Kaw, P.K.; Oberman, C. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). May 1978. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

Collisionless drift-wave eigenmodes in a sheared magnetic field are analyzed using the WKBJ method. It is found that, for L/sub s//L/sub n/ > (L/sub s//L/sub n/)/sub c/, ion-sound dynamics determines the eigenvalues at small $k^2/\text{sub y}/$ and the eigenmodes are damped. However, at large $k^2/\text{sub y}/$ electron dynamics dominates and the eigenmodes become marginally stable. For L/sub s//L/sub n/ < (L/sub s//L/sub n/)/sub c/, the eigenmodes are damped for all values of $k^2/\text{sub y}/$. The critical value (L/sub s//L/sub n/)/sub c/ scales as (m/sub i//m/sub e/)/sup 1/4/.

43923 **Wave energy in a beam plasma system.** Kirk, J.; Weiland, J. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Lett., A;* **64**: No. 2, 215-216(12 Dec 1977).

The question of the sign of the energy of the electrostatic wave which is excited in a beam plasma system is discussed. The relevance of this sign for the existence of an explosively unstable coupling to two positive energy waves is investigated. Weakly explosive instabilities are expected.

43924 **Electromagnetic ion-cyclotron instability vs. electrostatic ion-cyclotron instability in mixed (warm-cold)magnetospheric-like plasmas.** Cuperman, S.; Gomberoff, L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). *J. Plasma Phys.;* **18**: No. 3, 391-413(Dec 1977).

A systematic investigation and comparison of electromagnetic ion-cyclotron (e.m.) and electrostatic ion-cyclotron (e.s.) instabilities in uniform mixed warm and cold plasmas for magnetospheric-like plasma parameters is presented. The analytical and the numerical results are compared for each type of instability and next for various instabilities.

43925 **Electromagnetic effects on the electrostatic ion-cyclotron instability.** Gomberoff, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). *J. Plasma Phys.;* **18**: No. 3, 487-493(Dec 1977).

One possible mechanism for ring current proton losses is the electrostatic ion-cyclotron instability. Since typical ring-current parameters involve values of β of the order of one, the electron response must be treated electromagnetically. To this end, the effect of electromagnetic corrections on the electrostatic ion-cyclotron instability is discussed. It is shown that the electromagnetic response of the electrons has been only partially included in previous studies. A relatively simple expression for the growth rate, including all relevant corrections, is derived. On the basis of this expression, growth rates for typical ring-current parameters are calculated and compared with previous results. Flute-like modes are shown not to be affected by these corrections.

43926 **Effect of self-focusing on parametric back-scattering and absorptive instabilities in a plasma.** Sodha, M.S. (Drexel Univ., Philadelphia, Pa. (USA)); Kaushik, S.C.; Sharma, R.P. *J. Plasma Phys.;* **18**: No. 3, 551-561(Dec 1977).

An investigation is presented of the effect of self-focusing on the absolute growth rates of parametric back-scattering (e.g. stimulated Raman and Brillouin scatterings) and absorptive instabilities (e.g. two-plasmon decay and ion-plasmon decay) in a homogeneous and collisionless plasma. Gaussian intensity distribution of the pump laser beam causes the redistribution of carriers in the plane transverse to the beam propagation on account of the ponderomotive force, and leads the beam to propagate in an oscillatory wave guide mode. The modifications in plasma frequency and intensity of the beam cause the growth rates of the above parametric instabilities to show an oscillatory behaviour with the distance of propagation.

43927 **Reactive medium instability of the space charge wave of ion beam in a plasma.** Idehara, T.; Nakajima, K.; Ishida, Y. (Fukui Univ. (Japan)). *Phys. Lett., A;* **64**: No. 1, 53-55(28 Nov 1977).

The mesh-excited space charge wave of ion beam is observed to be amplified in a plasma, as the result of the reactive medium instability. The amplification factor has the maximum value at the frequency corresponding to the synchronization condition between the beam wave and the lower hybrid wave mode of plasma, and then, an appreciable deceleration of beam is expected from the observation of the decrease of the phase velocity of amplifying wave.

43928 **Experimental study of dynamic stabilization of dissipative drift modes by oscillating azimuthal magnetic field.** Mah, S.Q.; Boucher, C.; Teichmann, J.; van Andel, H.W.H. (Montreal Univ., Quebec (Canada). Dept. of Physics). *Phys. Lett., A;* **64**: No. 1, 49-50(28 Nov 1977).

The critical oscillating magnetic field for stabilization of collisional drift modes in a dc argon plasma at various static magnetic fields and neutral gas pressures was investigated and compared with theory.

43929 Orbit perturbation theory of beam-plasma instability. Ganguli, A.; Krishan, V.; Krishan, S.; Ravindra, M.P.; Sinha, K.P. (Indian Inst. of Science, Bangalore. Div. of Physics and Mathematical Sciences). *Plasma Phys.;* **19**: No. 11, 1085-1087(Nov 1977).

A study of the non-linear theory of the beam-plasma instability is presented. The instability is due to the interaction of a plasma with an electron beam passing through it. The non-linearity introduced by the field, due to the field acting back on the particles, serves as a stabilizing mechanism for the instability.

43930 Larmor radius effects on the gravitational instability of a two-component plasma. Chhonkar, R.P.S.; Bhatia, P.K. (Jodhpur Univ. (India)). *J. Plasma Phys.;* **18**: No. , p. 273-286(Oct 1977).

The gravitational instability of a two-component plasma is studied here to include simultaneously the effects of neutral gas friction, finite ion Larmor radius, magnetic resistivity and Hall currents. The viscosities of the two components of the plasma have also been taken into account. The mode of the transverse as well as the longitudinal wave propagation is discussed. The viscosities of the two components are found to have a stabilizing influence on the growth rate in this case since it is found that the increase of the viscosity effects reduces the growth rate. For the longitudinal mode also it is found that the effects of viscosities as well as that of neutral gas friction are stabilizing. The magnetic resistivity does not affect the growth rate since the equation determining the growth rate is found to be independent of this effect.

43931 Hydromagnetic stability of a jet of very high compressibility. Iyengar, H.K.S.; Chakraborty, B.B. (Bombay Univ. (India). Univ. Dept. of Chemical Technology). *J. Plasma Phys.;* **18**: No. , p. 289-292(Oct 1977).

The hydromagnetic stability of a cylindrical jet of a perfectly conducting and inviscid fluid of very high compressibility is studied. The fluid velocities and magnetic fields, inside and outside the jet, are uniform and in the axial direction, with possible discontinuities in their values across the jet surface. In the limit of infinite compressibility, the jet is stable against axisymmetric disturbances, but instability is present for asymmetric disturbances when the magnetic field is sufficiently small. For these disturbances the infinitely compressible jet behaves like an incompressible one when the wavenumber of disturbances is small. The effect of (infinite) compressibility becomes more evident as the wavenumber of disturbances increases and the jet becomes stable when the wavelength tends to vanish.

43932 Drift waves in a turbulent plasma. Mendonca, I.; Mendonca, J.T. (Instituto Superior Tecnico, Lisbon (Portugal). Complexo Interdisciplinar). *J. Plasma Phys.;* **18**: No. , p. 373-380(Oct 1977).

The dispersion equation of drift waves in the presence of electron-plasma turbulence in a plasma with magnetic shear is studied. It is shown that the shear stabilization can be cancelled out by a hot turbulent spectrum, even for a low level of turbulence, $W/n_0Te << 1$.

43933 Wall stabilization in a collisionless bumpy theta-pinch. Vahala, G.; Vahala, L. (College of William and Mary, Williamsburg, Va. (USA). Dept. of Physics). *J. Plasma Phys.;* **18**: No. , p. 317-337(Oct 1977).

Finite wavelength guiding centre plasma stability of the bumpy theta-pinch is examined by a normal mode analysis. It is shown that previous bumpy theta-pinch calculations are recoverable as special cases of this analysis. The ideal magneto-hydrodynamic and guiding centre plasma growth rates are compared for various pressure anisotropies and for various wavenumbers of the field line bumpiness. The well-posedness conditions on the guiding centre plasma equations are shown to give upper and lower bounds on the permissible pressure anisotropy which corresponds to the Alfven continuum staying on the stable side of the spectrum and to the particle mirror force not having a singularity. It is also found that the high azimuthal $M >= 2$ modes have growth rates larger than the $m = 1$ mode.

43934 Absolute parametric instability of potential oscillations in an anisotropic plasma with a two-dimensional inhomogeneity. Demchenko, V.V.; Omel'chenko, A.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Ukr. Fiz. Zh. (Russ. Ed.);* **22**: No. 5, 787-790(May 1977). (In Russian).

Equations describing parametric buildup of waves in inhomogeneous plasma are obtained. It is shown that such equations coincide with accuracy to redefinition of natural frequencies, with equations, describing parametric resonance in homogeneous plasma. Natural frequencies of oscillations can be obtained from solution of a boundary-value problem taking into account concrete spatial distribution of plasma density.

43935 Model analysis of Teller shell instability. Inogamov, N.A. (AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). *Pis'ma Zh. Tekh. Fiz.;* **3**: No. 7, 314-318(12 Apr 1977). (In Russian).

43936 Relaxation of high-current electron beams and modulation instability. Galeev, A.A.; Sagdeev, R.Z.; Shapiro, V.D.; Shevchenko, V.I. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). *Zh. Eksp. Teor. Fiz.;* **72**: No. 2, 507-517(Feb 1977). (In Russian).

The modulation instability of plasma noises in resonance with an electron beam is investigated, which occurs at relaxation of the high-current-energy beams in a cold plasma. The relaxation theory based on the weak turbulence equations is shortly surveyed, and its validity limits are established. A quantitative theory of the non-relativistic high-current beam relaxation is drawn. There is given a detailed analysis of the kinetic kink instability appearing on the relaxation of "spread" beams, $\Delta v/vsub(0)>(nsub(1)/nsub(0))sup(1/3)$ (Δv - velocity range in a beam; n_1, n_0 - beam and plasma density repsectively; $n_1 << n_0$). The effect of the modulation instability on the relativistic beam relaxation is also considered. The modulation instability is concluded to elongate substantially the collective relaxation process in the beam-plasma system.

43937 Convective excitation of quasistatic waves in an inhomogeneous anisotropic plasma. I. Linear theory. Jungwirth, K.; Sizonenko, V.L. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). *Czech. J. Phys.;* **27**: No. 3, 305-321(1977).

The local as well as the surface waves excited in a streamingless plasma are investigated. In addition to the gradient instabilities of an isothermal plasma, branches of a convective type are found in the plasma with a hot electron component, ZTsub(e parallel)>>Tsub(i perpend.). Both their frequencies and growth rates may exceed the ion cyclotron frequency even if the effect of the finite ion Larmor radius is negligible. The surface waves may be of considerable importance. Therefore, the conditions are compared of the excitation and the growth rates of the surface waves with those of the short wavelength (local) perturbations. Upper estimates of the saturated wave amplitudes are also given. For a particular profile of the plasma density the problem is solved analytically also in the plasma boundary layer.

43938 Particle aspect analysis of E x B drift instability in the presence of non-uniform electric field. Misra, K.D.; Tiwari, M.S. (Banaras Hindu Univ. (India). Inst. of Tech.). *Phys. Scr.;* **16**: No. 3, . 142-146(1977).

A physical mechanism and the dynamical details of the drift wave instability have been studied by investigating the trajectories of the charge particles in the presence of ambient magnetic field and non-uniform electric field. The effect of finite gyro-radius corrections have also been accounted. The general dispersion relation for the electrostatic drift wave has been obtained. The expression for the growth rate have been derived from an energy balance approach. The expression reduces to well known results under limiting conditions. The finite gyroradius correction due to inhomogeneous electric field is found to have a destabilising effect. The important geophysical situations for the existence of inhomogeneous electric field have been outlined and potential application of this result have been indicated.

43939 Plasma-neutral gas interaction effects on the stability of drift modes. Ohlsson, D.E. (Royal Institute of Technology, Stockholm, Sweden). *Phys. Scr.;* **15**: No. 5, . 318-324(1977).

In quasi-steady fusion reactors partially ionized boundary layers are likely to be formed. The plasma density is then expected to be peaked close to the boundary. The possibility of large density gradients driving unstable drift modes in these layers is investigated. The expected magnetic shear, due to induced plasma currents in such systems, as well as minimum-average-B properties of the magnetic field, are probably insufficient to significantly influence the stability properties of these models. However, effects associated with plasma-neutral gas interactions as well as with a finite Larmor radius and ion viscosity modify the behavior of drift modes and introduce stabilizing effects.

43940 Growth of modulational instability for randomized initial conditions. Weiland, J. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Scr.;* **16**: No. 3, . 137-141(1977).

The growth of the modulational instability has been studied in a one-dimensional configuration. In order to simulate a turbulent situation the phases of 31 Fourier components in space have been picked at random. Both stationary and moving solitons are obtained. Comparisons with the quasi-static approximation are made.

43941 Tearing instability in plasma configurations. Galeev, A.A.; Zelenii, L.M. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). *Zh. Eksp. Teor. Fiz.;* **70**: No. 6, 2133-2151(Jun 1976). (In Russian).

The development of tearing instability in a plasma with a diffusive neutral sheet is studied in the presence of a magnetic field component normal to the sheet with a small but finite amplitude. Already for very small amplitudes of the normal field the effect of

the component on the electron orbits near the neutral sheet results in stabilization of the electron tearing mode. Development of ion-tearing instability with a given wavelength is found to be possible only in a "split" or restricted range of values of the normal magnetic field components for which the effect of the normal component on the ion orbits in the neutral sheet may be neglected but the stabilizing contribution to the plasma dielectric permeability due to the magnetized electrons is already small. It is shown that "split" formation is possible only if the current in the sheet is sufficiently strong. Plasma states with values of the normal components lying below the unstable region are found to be metastable with respect to excitation of the ion-tearing mode.

43942 Teoriya plazmennykh neustojchivostej. Neustojchivosti odnorodnoj plazmy. (Plasma instability theory. Homogeneous plasma instability. Vol. 1). Mikhailovskii, A.B. Moscow; Atomizdat (1975). 272p. (In Russian).

The theory of instabilities in a homogeneous plasma is presented in this book. Plasma oscillations are considered as small perturbations of a stationary state. Effects linear in oscillation amplitude only are taken into account. This approximation is sufficient for elucidating conditions of instability development and for determining frequencies, wave numbers and increments of oscillations. In classification of oscillations and instabilities the magnetic field perturbation is predominant. If hagmetic field perturbations may be neglected, and an electric field perturbation may be expressed through the scalar potential gradient, such oscillations are assumed to be potential. The book deals with the potential instabilities in the absence and presence of a static magnetic field and also with nonpotential (electromagnetic) instabilities. In such an approach three principal mechanisms of instabilities can be seen: presence of charged particle beams in plasma, electric current and anisotropy of particle distribution in velocities.

PLASMA WAVE PHENOMENA

43943 (EUR-CEA-FC—912) **Wave absorption near the electron cyclotron frequency.** Fidone, I.; Granata, G.; Ramponi, G.; Meyer, R.L. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1977. 24p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Wave absorption for frequencies near the electron cyclotron frequency for the ordinary and extraordinary modes is investigated. The role of finite electron Larmor radius effects is discussed. A numerical analysis of the relevant dispersion relation in the weakly relativistic and non-relativistic limit is presented. The main results obtained are the density dependence 1/nsub(e) of the damping of the extraordinary wave for not too small densities and the strong absorption of the ordinary wave for quasi-perpendicular propagation in a hot plasma Tsub(e)>or approximately equal to 1keV).

43944 (N—78-11827) **Theory for stationary nonlinear wave propagation in complex magnetic geometry.** Watanabe, T.; Hojo, H.; Nishikawa, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1977. 30p. (IPPJ—300). NTIS PC A03/MF A01.

A method was developed for calculating nonlinear wave propagation in the self-consistent plasma profile in complex magnetic-field geometry. Basic assumptions and/or approximations include use of the collisionless two-fluid model with an equation of state restriction to a steady state propagation, and existence of modified magnetic surface, with modification due to Coriolis' force. Situations studied are: (1) weak-field propagation without static flow; (2) arbitrary field strength with flow in axisymmetric system; (3) weak field limit of case 2; and 4 arbitrary field strength in nonaxisymmetric torus. Except for case 3, a simple variation principle was derived by introducing appropriate coordinates. In cases 1 and 3, explicit results for quasilinear profile modification were obtained.

43945 Acceleration of trapped particles by a Langmuir wave in an inhomogeneous plasma. Dysthe, K.B.; Gudmestad, O.T. (Tromsoe Univ. (Norway)). *J. Plasma Phys.;* **18**: No. 3, 509-523(Dec 1977).

The acceleration of trapped particles by a Langmuir wave in an inhomogeneous plasma is investigated for different density profiles. In particular the important case of a wave moving towards its reflexion point is considered both analytically and numerically. To obtain estimates of the energy gain of the trapped particles, their stability is investigated. The findings differ from those of previous investigations. The effect of wave damping, and a slowly varying frequency (whistler-like phenomena), on the stability of trapping is estimated.

43946 Slowly varying nonlinear waves in a cold plasma stream. Gribben, R.J.; Parkes, E.J. (Strathclyde Univ., Glasgow (UK). Dept. of Mathematics). *J. Plasma Phys.;* **18**: No. 3, 495-508(Dec 1977).

The propagation of one-dimensional nonlinear waves in the relatively simple physical situation of a cold, collisionless, field-free, slightly non-uniform plasma comprising a stream of oscillating electrons and a stream of ions whose oscillatory motion is neglected, is discussed. The waves are considered as a small perturbation from the corresponding uniform periodic solution. The equations which govern the slow variation of certain gross quantities associated with the waves are obtained by applying the 'two-timing' technique to the basic plasma equations. The properties of the resulting modulation equations are discussed and an exact solution of an initial value problem for them is given.

43947 Nonlinear propagation of the ordinary mode in a hot magnetoplasma. Khiet, T. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas); Furutani, Y.; Ichikawa, Y.H. *J. Plasma Phys.;* **18**: No. 3, 433-449(Dec 1977).

Kinetic theory of the self-modulation of a quasi-monochromatic ordinary wave propagating across an external magnetic field in presented. Explicit expressions of the dispersion and the nonlinear coupling coefficients are given for a Maxwellian plasma. In the limit of zero-temperature, a Karpman-Kruskal linear stability of the O-mode envelope is discussed.

43948 Ion-acoustic solitons in an electromagnetically irradiated magnetoplasma. Patel, L.A. (Indian Inst. of Tech., New Delhi. Dept. of Physics). *J. Plasma Phys.;* **18**: No. 3, 381-389(Dec 1977).

The influence of an electromagnetic beam and a static magnetic field on the ion-acoustic solitons in a plasma is investigated. A modified KdV equation is derived in which the electromagnetic field plays the role of a source term. By using the perturbation analysis technique, it is shown that a homogeneous electromagnetic beam does not destabilize the ion-acoustic solitons; it reduces the amplitude, but not the velocity, of the solitons. However, any inhomogeneity in the electromagnetic field intensity does destabilize the ion-acoustic solitons; albeit not to an appreciable extent for typical cases.

43949 Electron oscillations of a collisionless plasma in a static electric field. Wahlberg, C. (Uppsala Univ. (Sweden)). *J. Plasma Phys.;* **18**: No. 3, 415-431(Dec 1977).

The influence of a static electric field on electron oscillations of (i) a cold beam of electrons and (ii) a hot non-drifting plasma is investigated. The importance of the relative strength of the field is emphasized. In the weak field limit the oscillations are adiabatic, manifested by the existence of adiabatic invariants, preservation of eigenmodes and absence of reflexion. If the field is strong, however, interesting new features, such as mutual coupling of eigenmodes and wave reflexion, appear. Possible stability properties of a monotonic electrostatic transition (shock, double layer) are also discussed.

43950 Dynamics of four coupled plasma waves to second order. Walters, D.; Lewak, G.J. (California Univ., San Diego, La Jolla (USA). Dept. of Applied Physics and Information Science). *J. Plasma Phys.;* **18**: No. 3, 525-536(Dec 1977).

General equations are derived for the interaction of four waves to second order (i.e. two triplets with two waves common to both). The solutions are analysed under various initial conditions and it is shown that the weaker triplet (as measured by the coupling constraints) is stabilized by the stronger one against explosive instabilities, whereas the converse does not happen. It is further found that under certain circumstances one of the common waves may act as a 'catalyst', remaining fixed in amplitude, while the other waves oscillate or even grow exponentially. The work is extended to include the possibility of negative energy waves.

43951 Filamentation of lower-hybrid turbulence by adiabatic perturbations in a magnetized plasma. Tagare, S.G.; Zhelyazkov, I. (Bochum Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). *Phys. Lett., A;* **64**: No. 1, 56-58(28 Nov 1977).

It is shown that stationary turbulence consisting of an ensemble of small amplitude lower hybrid wave packets becomes unstable against adiabatic perturbations along the external magnetic field. The growth rate and the threshold of the instability are calculated.

43952 Soliton flash, turbulent ion heating, and relaxation oscillations in strong Langmuir turbulence. Elsaesser, K.; Schamel, H. (Bochum Univ. (Germany, F.R.)). *Plasma Phys.;* **19**: No. 11, 1055-1073(Nov 1977).

The mode coupling equations for Langmuir and ion acoustic waves are derived including an external electric field Esub(ext)(t), nonlinear ion terms, Landau damping, and (turbulent) ion viscosity. A numerical scheme for integrating these equations shows excellent conservation of invariants and of stationary solutions for Esub(ext)(t) = 0 and zero dissipation. The numerical solutions show (a) a transient solitary wave structure ('soliton flash'), (b) a turbulent quasi-stationary state in which ions are heated predominantly, and (c) two kinds of relaxation oscillations depending upon the ion viscosity. Comparison with recent experiments shows qualitative agreement.

43953 Effect of growth-rate modulation on the nonlinear mode coupling between stable and unstable plasma waves. Anderson, D.; Bondeson, A.; Falk, L. (Chalmers Tekniska Hoegskola, Goeteborg

(Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). *J. Plasma Phys.;* **18**: No. , p. 363-372(Oct 1977).

An investigation is made of the effect of an external growth-rate modulation on the saturation of a linearly unstable plasma wave by means of nonlinear Landau damping. Different ways of exciting the saturated system by suitable choices of modulation frequency are discussed and the characteristics of the resulting instabilities, like thresholds, growth-rates, maximum amplitudes and final saturation levels are determined.

43954 Note on the Lagrangian method for nonlinear dispersive waves. Kawahara, T. (Kyoto Univ. (Japan). Dept. of Physics). *J. Plasma Phys.;* **18**: No. , p. 305-316(Oct 1977).

A few remarks are made on the method of the averaged Lagrangian developed by Whitham to describe slow variations of nonlinear wave trains. The concepts of multiple scales is incorporated into the variational formalism, and a consistent development to higher approximation is suggested as formal perturbation based on the variational principle. The propagation of weakly dispersive long waves is also reconsidered in relation to the Lagrangian method. It is demonstrated that the non-linear Schroedinger equation and the Korteweg-de Vries equation can be derived from the Euler-Lagrange equations of the perturbed Lagrangian.

43955 Overlooked perturbations and completeness. Krueger, J.G. (Ghent Rijksuniversiteit (Belgium). Seminarie voor Wiskundige Natuurkunde). *J. Plasma Phys.;* **18**: No. , p. 287-288(Oct 1977).

43956 Nonlinear propagation of high-frequency plasma waves in a magnetized plasma. Shukla, P.K. (Bochum Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). *J. Plasma Phys.;* **18**: No. , p. 249-256(Oct 1977).

Nonlinear effects associated with large amplitude electron plasma waves propagating at an arbitrary angle to the external magnetic field are studied. It is shown that the non-linear coupling of high-frequency plasma waves with static density perturbations leads to a convective instability. The growth length of the latter is obtained. The evolution of the wave electric field is also investigated.

43957 Self-focusing of electromagnetic waves as a result of relativistic electron-mass variation. Spatschek, K.H. (Essen Univ. (Gesamthochschule) (Germany, F.R.)). *J. Plasma Phys.;* **18**: No. , p. 293-303(Oct 1977).

Relativistic electron-mass variations due to the presence of intense electromagnetic radiation in the plasma cause a nonlinear refractive index. Using a variational principle the latter is obtained up to fourth order in the electric field amplitude and it is shown that nonlinear effects of the second order lead to self-focusing of a beam of radiation. By nonlinear optics considerations, the self-focusing length of an axially symmetric beam is obtained. Including higher-order dispersive effects it is shown that within the thin-beam approximation the complex electric field envelope obeys a cubic nonlinear Schroedinger equation with an attractive self-consistent potential. The cylindrically symmetric nonlinear Schroedinger equation predicts collapse of the radiation at the self-focusing distance. The nature of the self-focusing singularity is analysed and it is shown that higher-order nonlinearities saturate the amplitude. Then oscillations of the beam radius along the axial direction occur.

43958 Ray velocity surface and the CMA diagram. Walker, A.D.M. (Natal Univ., Durban (South Africa)). *J. Plasma Phys.;* **18**: No. , p. 339-346(Oct 1977).

The CMA diagram as a means for classifying electromagnetic wave propagating in cold plasmas is generalized to include boundaries on which the ray surface, rather than the refractive index or wave normal surface, undergoes topological changes. Since the ray surface has the shape of a wavefront for a wave originating from the point source, such boundaries are of importance in understanding wave behaviour. Formulae are presented applying to the case of a cold plasma including the effect of positive ions. Calculations are presented for the special case of a hydrogen plasma.

43959 Transformation of an electromagnetic wave into nonlinear plasma waves in the range of a hybrid resonance. Demchenko, V.V.; Lebedev, P.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Ukr. Fiz. Zh. (Russ. Ed.);* **22**: No. 5, 705-712(May 1977). (In Russian).

It is shown that taking account of the HF field pressure and thermal motion of plasma particles leads to the restriction of a "swelling" component of the electrical field amplitude in the range of a hybrid resonance in inhomogeneous plasma. Spatial dependence of the electrical field amplitude is single-valued at any coordinate value.

43960 Total resonance absorption of electromagnetic radiation in an inhomogeneous plasma. Aliev, Yu.M.; Gradov, O.M.; Kirij, A.Yu. (AN SSSR, Moscow. Fizicheskii Inst.); Vukovich, S.; Chadezh, V. (Belgrade Univ. (Yugoslavia). Inst. za Fiziku). *Pis'ma Zh. Eksp. Teor. Fiz.;* **25**: No. 8, 351-354(20 Apr 1977). (In Russian).

43961 Resonance absorption of electromagnetic waves in an inhomogeneous plasma. Zharov, A.A.; Kondrat'ev, I.G.; Miller, M.A. *Pis'ma Zh. Eksp. Teor. Fiz.;* **25**: No. 8, 355-357(20 Apr 1977). (In Russian).

43962 Interaction of a supercritical initial velocity beam with finite amplitude waves. Bakai, A.S.; Krivulya, S.S.; Onishchenko, I.N.; Fedorchenko, V.D. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Zh. Eksp. Teor. Fiz.;* **72**: No. 2, 499-506(Feb 1977). (In Russian).

The experimental and theoretical investigation has been conducted to study the modes of wave amplification in a confined plasma by a monoenergetic electron beam at several beam initial velocities and wave inlet amplitudes. Dispersion curves for the wave phase velocity have been measured and the beam-maximum-energy loss conditions determined. The results of computer simulation are discussed and compared with experiments. It is shown that a beam with a supercritical velocity (i.e. larger than the maximum phase velocity of the plasma wave) may transfer up to 60% of its energy to the wave. Beams with supercritical velocities are pointed out to be more efficient in the confined plasma wave amplification than subcritical beams.

43963 Theory of electrosound waves in a plasma. Tsintsadze, N.L.; Tskhakaya, D.D. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). *Zh. Eksp. Teor. Fiz.;* **72**: No. 2, 480-487(Feb 1977). (In Russian).

The nature of electrosound waves in a plasma with a negative dielectric permittivity is investigated in strong H/F fields in which the plasma electrons may acquire relativistic velocities. Corresponding hydrodynamic equations are formulated. A solution to the equations is investigated for the case of stationary waves spreading in the plasma with a constant velocity. It is shown, that if the pressure of the H/F waves exceeds the hydrodynamic pressure the electrosound wave is a compression wave, whereas in weak HF fields it is a refraction wave.

43964 Nonlinear resonance phenomena of plasma oscillations by parametric excitation. Kozima, H. (Shizuoka Univ. (Japan). Dept. of Physics). *Rep. Fac. Sci., Shizuoka Univ.;* **11**: 25-45(Feb 1977).

Nonlinear resonance effects of electron and ion plasma oscillations by parametric excitation were investigated in mercury plasmas. Nonlinear increase of intensity of excited oscillations and hysteresis phenomena were observed in the parametric excitations of the electron and ion plasma oscillations. These phenomena observed in the electron and ion plasma oscillations were consistently explained in terms of theories based on the parametric resonances due to the nonlinear density modulation and the nonlinear density gradient, respectively. A parametric excitation of the low frequency oscillations in a static magnetic field was also observed where the intensity of excited oscillations depended nonlinearly on the intensity of the incident rf field. Three-wave excitation of the low frequency oscillations was studied.

43965 Resonant wave interactions in inhomogeneous media. Anderson, D. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Scr.;* **15**: No. 5, . 331-334(1977).

Using a simple physical approach the maximum amplification of parametric processes in inhomogeneous plasmas is determined for various cases including arbitrary wave dampings. The analysis is extended to include the pump wave equation assuming heavy damping of one of the decay waves (nonlinear Landau damping). The inhomogeneity in this case decreases the energy transfer between the modes as compared to the homogeneous situation.

43966 Forced radial oscillations of a fully ionized cylindrical plasma surrounded by a partially ionized plasma shell. Bures, M.; Tennfors, E. (Royal Institute of Technology, Stockholm, Sweden). *Phys. Scr.;* **16**: No. 3, . 117-122(1977).

Forced radial magnetoacoustic oscillations of a fully ionized cylindrical plasma, surrounded by a partially ionized shell are excited by means of an external source. The radial plasma profiles of the macroscopic field quantities in the fully and partially ionized regions are obtained as functions of the degree of ionization, the temperature and the position of the boundary between the two regions. The absorbed power is calculated. The nonresonant as well as the resonant cases are treated. It is shown that the main part of the power is absorbed in the outer shell unless a suitable resonance is used to enhance the macroscopic field quantities in the fully ionized plasma part and the dimensions of the outer shell are kept small.

43967 Excitation of ordinary waves in a diffuse boundary plasma under an anomalous skin effect. Vasil'ev, A.N. (Moskovskij Gosu-

darstvennyj Univ. (USSR)). *Zh. Eksp. Teor. Fiz.;* **71**: No. 6, 2113-2125(Dec 1976). (In Russian).

Absorption of an electromagnetic wave by a plasma with a diffuse boundary is studied. The decrease of the particle concentration is assumed to be exponential and the magnetic field to be parallel to the plasma boundary. It is shown that collisionless absorption of waves, the electric vector of which is directed along the magnetic field, involves the excitation of ordinary waves in the plasma at those concentrations at which the waves may exist in a homogeneous plasma. The line shapes of the electron and ion absorption resonances are studied, particularly in the effective collision frequency approximation. Expressions are obtained for the limits of existence of ordinary cyclotron waves in a plasma and the dispersion equation is solved for a homogeneous high pressure plasma.

43968 Stimulated raman scattering and penetration of an electromagnetic wave into an inhomogeneous plasma. Gorbunov, L.M.; Domrin, V.I.; Ramazashvili, R.R. (AN SSSR, Moscow. Fizicheskij Inst.). *Zh. Eksp. Teor. Fiz.;* **70**: No. 6, 2161-2177(Jun 1976). (In Russian).

Relations from which the intensity of noise and intensity of a pumping wave in an inhomogeneous medium can be determined under conditions of convective parametric instability are derived on basis of nonlinear electrodynamic equations. The relations are employed for investigating the effect of stimulated Raman scattering on the penetration of an electromagnetic wave into a rarefied inhomogeneous plasma.

43969 To the theory of damping of magneto hydrodynamic waves in a high-temperature plasma. Akhiezer, A.I.; Lapshin, V.I.; Stepanov, K.N. (Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)). *Zh. Eksp. Teor. Fiz.;* **70**: No. 1, 81-91(Jan 1976). (In Russian).

Absorption is considered of electromagnetic waves with a frequency smaller or of the order of the cyclotron frequency of ions in a weakly collisional plasma whose pressure is small compared with the magnetic pressure. Allowance is made for absorption of waves due to the Cherenkov interaction between the waves and electrons, friction between ions of various types and between electrons and ions, electron viscosity and ion viscosity. The role of these processes in high frequency plasma heating is discussed.

FUSION POWER PLANT TECHNOLOGY

43970 (AD-A—047822) **Generation of a reversed-field plasma, confinement configuration with a rotating relativistic electron beam. Interim report.** Sethian, J.D.; Hammer, D.A.; Gerber, K.A.; Spector, D.N.; Robson, A.E. (Naval Research Lab., Washington, D.C. (USA)). Nov 1977. 42p. (NRL-MR—3648). NTIS PC A03/MF A01.

A reversed-field plasma confinement geometry has been produced by plasma currents induced by a rotating relativistic electron beam injected into 85 mTorr neutral hydrogen. The resulting belt-pinch-like configuration has a rectangular cross-section, with length-to-width ratio of 20, and a midplane beta = .5. An equilibrium model, fitted to measurements of the excluded flux and induced axial (Delta B sub Z) and azimuthal (B sub Theta) magnetic fields, is in agreement with the annular plasma profile observed with radial thomson scattering scans, CO2 interferometry and end-on streak photographs. After beam passage, Delta B sub Z remains constant for 5 microseconds until B sub Theta becomes small, at which time the plasma collapses radially. The observed decay times of 4 microseconds, and concurrent increase in T sub e (from 5-to-10eV) are consistent with classical dissipation of the induced currents. (Author)

43971 (EPRI-ER—714) **Assessment of the tokamak confinement data base. Final report.** Aamodt, R.E.; Byrne, R.N.; Fleischmann, H.; Gentle, K.W.; Krall, N.A.; Taylor, R.J.; Trivelpiece, A.W. (Science Applications, Inc., La Jolla, Calif. (USA)). Mar 1978. 119p. Dep. NTIS, PC A06/MF A01.

This report contains the results of an early 1977 survey of the tokamak physics data base. The important tokamak physics characteristics necessary for developing a fusion reactor were first identified. Then an aggressive survey was carried out to establish the range of relevant parameters that has been achieved in tokamak experiments, the diagnostic techniques and their reliability in determining these parameters, and the state of the understanding of the basic physical laws causing the performance limitations. These findings are detailed in this report, along with our overview of the state of the present tokamak fusion reactor program and suggestions which we feel will enhance the expansion of the data base if incorporated in the planning for future experiments. Additionally, a brief status report of the mirror fusion reactor program is included.

43972 (GA-A—14614(Vol.1)) **GAC—ANL TNS Scoping Studies. Status report for FY-77, October 1, 1976—September 30, 1977. Volume I. Summary.** (General Atomic Co., San Diego, Calif. (USA)). Jan 1978. Contract EY-76-C-03-0167-038. 60p. Dep. NTIS, PC A04/MF A01.

This volume, the first of a total of eleven, summarizes the major results of a one-year effort in a continuing study of the TNS (The Next Step) program being funded by the Department of Energy. In this study, five candidate reactors were identified, ranging from a copper toroidal field coil ignition test reactor (ITR) with a 10 second burn and a 0.1 duty factor to a superconduting TF coil ignition test reactor which can be upgraded to an experimental power reactor. Study emphasis was placed on a 3.8 m ITR with superconducting TF coils designed for a 30 second burn and a duty factor of 0.1. The results indicate that such a reactor is technically feasible and that it can be built in about 6-½ years after completion of a 3-year program of conceptual design and initial preliminary design. The cost of this particuler facility is approximately $475 million (1977 dollars) without escalation and R and D costs.

43973 (GA-A—14939) **Preliminary conceptual design of the blanket and power conversion system for the Mirror Hybrid Reactor.** Schultz, K.R.; Culver, D.W.; Rao, S.B.; Rao, S.R. (General Atomic Co., San Diego, Calif. (USA)). Apr 1978. Contract EY-76-C-03-0167-038. 10p. Dep. NTIS, PC A02/MF A01.

A conceptual design of a commercial Mirror Hybrid Reactor, optimized for ^{239}Pu production, has been completed. This design is the product of a joint effort by Lawrence Livermore Laboratory and General Atomic Company, and follows directly from earlier work on the Mirror Hybrid. This paper describes the blanket and power conversion system of the reactor design. Included are descriptions of the prestressed concrete reactor vessel that supports the magnets and contains the blanket and power conversion system components, the blanket module design, the blanket fuel design, and the power conversion system.

43974 (UCID—17644) **Standard mirror fusion reactor design study.** Moir, R.W. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1978. Contract W-7405-ENG-48. 541p. Dep. NTIS, PC A23/MF A01.

This report covers the work of the Magnetic Fusion Energy Division's reactor study group during FY 1976 on the standard mirror reactor. The "standard" mirror reactor is characterized as a steady state, neutral beam sustained, D-T fusioning plasma confined by a Yin-Yang magnetic mirror field. The physics parameters are obtained from the same physics model that explains the 2XIIB experiment. The model assumes that the drift cyclotron loss cone mode occurs on the boundary of the plasma, and that it is stabilized by warm plasma with negligible energy investment. The result of the study was a workable mirror fusion power plant, steady-state blanket removal made relatively simple by open-ended geometry, and no impurity problem due to the positive plasma potential. The Q (fusion power/injected beam power) turns out to be only 1.1 because of loss out the ends from Coulomb collisions, i.e., classical losses. This low Q resulted in 77% of the gross electrical power being used to power the injectors, thereby causing the net power cost to be high. The low Q stimulated an intensive search for Q-enhancement concepts, resulting in the LLL reactor design effort turning to the field reversal mirror and the tandem mirror, each having Q of order 5.

43975 Konferenz ueber Energie und technologische Entwicklung: die Loesung der Energiekrise. (Conference on energy and technological development: solution to the energy crisis). Wiesbaden, Germany, F.R.; Campaigner Verl. (1977). vp. (In German). (AED-Conf—77-301-000; CONF-7706121—).

From Conference on energy and technological development) solution to the energy crisis; Essen, F.R. Germany (6 Jun 1977).

Abstracts for each paper have been entered into the data base. (MOW)

43976 Basic features of EXTRAP concept. Lehnert, B. *Phys. Scr.;* **16**: No. 3, . 147-155(1977).

The potentialities and properties are discussed of a recently suggested axially symmetric, quasi-steady, closed, high-beta magnetic confinement system. A toroidal pinch of non-circular cross section is immersed in the strong, inhomogeneous poloidal vacuum field from a set of ring-shaped conductors, all carrying currents in the opposite direction of the plasma current. This 'EXTRAP' concept is expected to have some important advantages, as compared to magnetic bottles based on a main toroidal field component. Concerning plasma equilibrium, there are closed local and average guiding centre orbits, beta values of order unity should become available, there is no magnetic surface splitting limit, cyclotron radiation should be kept at a comparatively low level, and bootstrap operation may become possible. Concerning plasma stability, the system should not become sensitive to magnetic island formation and asymmetries, and the short magnetic connection lengths as well as the strong vacuum field gradients should favour stabilization of flute-type, kink, and other magnetohydrodynamic modes. Concerning reactor technology, high power densities are expected to be reached, superconducting coils should not become necessary, the coil stresses

are moderate, and repair and replacement are facilitated by the coil geometry. Before a final judgement can be made on this concept, however, extensive experiments and further theoretical analysis are needed.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 42989, 43857

43977 (LA-UR—78-964) **Scoping nucleonic studies for the RIGGATRON fusion reactor concept.** Wienke, B.R.; Dudziak, D.J.; Bosler, G.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 8p. (CONF-780508—5). Dep. NTIS, MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Portions of document are illegible.

Results of S/sub N/ and Monte Carlo one-dimensional neutron/gamma-ray transport calculations for conceptual designs of the INESCO RIGGATRON, a Tokamak device using ohmic heating to induce fusion, are detailed. Using various plasma, coil, and blanket configurations, a comparative analysis of cross-section sets is first performed. Scoping calculations of tritium breeding ratios, absorptions, leakages, and neutron/gamma-ray heating are detailed using both multigroup discrete-ordinates and Monte Carlo techniques. Results of this analysis not only serve to provide preliminary design parameters, but also indicate relative degree of consistency among various cross-section sets. Consistency between S/sub N/ and Monte Carlo techniques is similarly demonstrated. Results of this one-dimensional compilation also suggest a two-dimensional RIGGATRON model for related study.

43978 (LA-UR—78-1197) **Nucleonic aspects of the LINUS imploding blanket.** Dudziak, D.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 9p. (CONF-780508—4). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Nucleonic analyses have been performed for the Naval Research Laboratory's imploding-liner fusion reactor concept called LINUS. Mixtures of Pb and LiPb were used for the liquid metal liner (blanket), with blanket thickness, LiPb fraction, and Cd poisoning concentration being varied in scoping studies. Investigated responses were tritium breeding ratio, neutron leakage from the liquid liner to permanent reactor structure, and time-dependent nuclear heating of the liner and permanent structure. Tritium breeding ratio was as high as 1.8 for blankets sufficiently thick (approximately 1 m) to reduce leakage to the permanent structure to tolerable levels. Approximately 98.4% of the energy is deposited in the blanket within 10 μs, providing confidence that the heating of LINUS's blanket will occur while it is mechanically secure.

43979 (LA-UR—78-1198) **Minimum-thickness blanket/shield with optimum tritium breeding and shielding effectiveness.** Gerstl, S.A.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 11p. (CONF-780508—3). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A blanket/shield assembly for a fusion reactor has been designed through extensive optimization studies. The design was optimized under the following constraints: (a) minimum overall thickness, (b) tritium breeding ratio of 1.10, (c) thermal energy recovery of 90%, (d) acceptably flat temperature distribution, and (e) excluding all "exotic" or problematic materials. The optimized blanket/shield has an overall thickness of 36 cm and conforms with all the above requirements. All tritium breeding is accomplished in a 24-cm-thick breeding zone using stagnant enriched lithium-6, and lead as a neutron multiplier. The energy recovery in this breeding zone is 71% which, together with an additional energy extraction of 19% in a 12-cm-thick laminated stainless steel/boron carbide shield zone, results in the desired overall thermal efficiency of 0.90 which is considered adequate if normal-conducting magnets are used for plasma confinement.

43980 (TRITA-PFU—77-06) **Ionization and burnout processes of a magnetically confined plasma.** Lehnert, B. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Oct 1977. 25p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The particle and heat balance during plasma start-up are investigated, to specify the conditions for reaching various ion density ranges and high plasma temperatures in cases of a limited heating power. Particular attention is paid to the permeable-impermeable transition regime of plasmas being subject to Ohmic heating and confined in closed or open bottles with a main poloidal field. The ionization and burnout conditions are found to depend critically on the confinement and the filling density. They become optimal in closed bottles under symmetric and stable conditions, where the transition into a fully ionized state should be reached even at moderately large ionization rates, burnout powers and currents. Start-up methods based on constant as well as on variable filling densities are discussed as means of ion density control.(author).

43981 (UCRL—52000-78-2, pp 9-14) **Pulsed sphere measurements for weapons and fusion reactor design.** Feb 1978.

In Energy and technology review.

Pulsed sphere measurements provide a way of validating the Monte Carlo transport codes and the input cross sections used in the design of thermonuclear weapons and fusion reactors. In these measurements pulsed 14-MeV neutrons are generated at the center of spheres of materials to be investigated, and the emitted neutron spectrum is measured by time-of-flight techniques. The measurements described in this article cannot reproduce the complex conditions found in weapons and fusion reactors. However, agreement between measurement and calculations for a simple geometry and one material (or simple composites) is a necessary prerequisite to reliable fusion reactor calculations.

43982 **Bumper wall for plasma device.** Coultas, T.A. (to Energy Research and Development Administration). US Patent 4,052,999. 11 Oct 1977. Filed date 15 Jul 1975. 4p.

PAT-APPL-596,043.

Operation of a plasma device such as a reactor for controlled thermonuclear fusion is facilitated by an improved bumper wall enclosing the plasma to smooth the flow of energy from the plasma as the energy impinges upon the bumper wall. The bumper wall is flexible to withstand unequal and severe thermal shocks and it is readily replaced at less expense than the cost of replacing structural material in the first wall and blanket that surround it.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 44011

43983 (EUR-CEA-FC—908) **Magnetic turbulence in Tokamaks.** Samain, A. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1977. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

From a discussion of the disruption process, it is concluded that this process plausibly consists of the onset of a fine grain turbulence. This turbulence must be able to produce the large values of the inductive electric field which are associated with the reorganization of the poloidal flux and the current density on the magnetic surfaces. It is then plausible that the turbulence belongs to a class of 'rippling' modes, that may explain the experimental values for the magnetic perturbations corresponding to a substantial radial ergodicity of the flux lines. The stability of the modes in the presence of such an ergodicity is accordingly considered. It is found that the modes may be unstable even in collisionless regime, the ergodicity playing a role similar to the resistivity to partially remove the M.H.D. constraint.

43984 (KFTI—75-23) **Rotational transformation for traps with 2- and 3-cut helical windings.** Nemov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1975. 23p. (In Russian). Dep. NTIS (US Sales Only), PC A03/MF A01.

Rotational transformation for traps with 2- and 3-cut helical windings. An analytical and numerical study is presented, in the straight systems approximation, of the rotational transform in containments having a flat magnetic axis, as a function of the parameters of 2- and 3-cut helical windings and their combinations. Rotational transform in such systems is compared with that in confinement systems having a helical magnetic axis. It is shown that when a 2-cut winding is used the rotational transform of the systems examined can be of the same order of magnitude as in confinement systems having helical magnetic axes. Confinement systems having 2-cut thorsatron windings exhibit shear, near the magnetic axis, of the same order of magnitude as in the 3-cut case, when a fourth harmonic of the helical variable is present in the components of the helical field. The application of 2- and 3-cut correlations of helical windings allows the application of independent control of rotational transform and shear in confinement systems having a flat magnetic axis (stellarators, thorsatrons). In terms of their potential for control of rotational transform and shear, confinement systems having combined windings are not inferior to systems with helical magnetic axes, while their design is simpler than that of the latter.

43985 (PPPL—1433) **Numerical study of magnetic islands near the PDX separatrix.** Brown, D.I. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Apr 1978. Contract EY-76-C-02-3073. 24p. Dep. NTIS, PC A02/MF A01.

The effects of perturbations on the magnetic surfaces near the PDX divertor separatrix were studied numerically. The width of

magnetic islands in this region is in very close agreement with linearized models provided that the divertor ergodic region does not envelope the island. The width of the ergodic region was found to be linear with perturbation amplitude, again in agreement with analytic models. These numerical results indicate that the mechanical tolerances on the vertical positions of the PDX internal divertor coils will produce an ergodic region with a width of approximately 0.5 cm which is less than the 1-2 cm expected plasma width in the divertor scrape-off region.

43986 Some notes on the calculation of the magnetic field produced by a toroidal thick coil. Arcipiani, B.; Pedretti, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). *Nucl. Instrum. Methods;* **147**: No. 3, 571-575(15 Dec 1977).

The magnetic field produced by a thick current-carrying toroidal coil having an arbitrary angular aperture was investigated in suitable coordinates.

43987 Magnetic field-line reconnexion by localized enhancement. Pt. 2. Quasi-steady process. Tsuda, T. (Hokkaido Univ., Sapporo (Japan)); Ugai, M. *J. Plasma Phys.;* **18**: No. 3, 451-471(Dec 1977).

It is demonstrated by numerical experiment that the evolutionary process of magnetic field-line reconnexion by a localized enhancement of resistivity is eventually checked, with the system attaining a quasi-steady state. On the basis of the quasi-steady configuration, established from an initially antiparallel magnetic field, the MHD properties that are characteristic of the diffusion, field reversal and external regions, respectively, and then the mutual dependence among them may be clarified. The physical processes in the diffusion region are especially note-worthy, since the ultimate cause for the present reconnexion process is the bending of the field lines towards the magnetic neutral point, which results from the locally enhanced resistivity assumed in the diffusion region. The present numerical results generally agree with the analytical results for the steady reconnexion, although some discrepancies exist owing to the differences of the postulated basic situations between them. It is pointed out that changes in flow properties across the boundary of the field reversal region agree well with those required for a slow mode compression wave and that the dominant process in the external region corresponds to a fast mode expansion.

43988 Device for supporting a toroidal coil in a toroidal type nuclear fusion device. Kitazawa, H.; Sato, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 197,759,298/A/. 11 Nov 1975. 3p. (In Japanese).

Object: To easily manufacture a center block having a strength sufficient to withstand an electromagnetic force exerted on the center of toroidal of a toroidal coil and to increase its reliability. Structure: In a device for supporting toroidal coils wherein the electromagnetic force exerted on the center of toroidal of a plurality of toroidal coils arranged in toroidal fashion, the contact surface between the toroidal coil and the center block is arranged parallel to the center axis of toroidal so as to receive the electromagnetic force exerted on the center of toroidal of the toroidal coil as the component of force in a radial direction.

POWER SUPPLIES, ENERGY STORAGE

43989 (CONF-771029—209) **Voltage protection scheme for MG sets used to drive inductive energy storage systems.** Campen, G.L.; Easter, R.B. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

A recent tokamak proposal at ORNL called for MG (motor-generator) sets to drive the ohmic heating (OH] coil, which was to be subjected to 20 kV immediately after coil charge-up to initiate the experiment. Since most rotating machinery is inherently low voltage, including the machines available at ORNL, a mechanism was necessary to isolate the generators from the high voltage portions of the circuit before the appearance of this voltage. It is not the expected 20 kV at the coil that causes difficulty, because the main interrupting switch handles this. The voltage induced in the armature due to di/dt and the possibility of faults are the greatest causes for concern and are responsible for the complexity of the voltage protection scheme, which must accommodate any possible combination of fault time and location. Such a protection scheme is presented in this paper.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 43973

HEATING AND FUELING SYSTEMS

43990 (CONF-771238—1) **Positive ion systems: state of the art and ultimate potential.** Haselton, H.H. (Oak Ridge National Lab., Tenn. (USA)). 6 Dec 1977. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From Workshop on plasma heating development requirements; Washington, DC, USA (5 Dec 1977).

The PLT or ISX-B ion source has been operated at 40-keV, 60-A, and 0.3-sec pulses with H(D) neutral injected power of 750 kW (approximately 1000 kW) on the PLT device. This report gives a brief description of this system and some future plans. (MOW)

43991 (UCID—17583) **Cesium—tungsten cathode for surface production of D^-.** Anderson, O.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Mar 1977. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

In the next generation of neutral beam systems for fusion, beam energy and efficiency requirements will go up, and high current D^- sources will be needed. The purpose of this note is to examine the problem of maintaining the cathode near its optimun state for the case of the supersonic jet conversion system. (MOW)

43992 (UWFDM—226) **Neutral beam divergence due to imperfect magnetic shielding.** Conrad, J.R. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Nov 1977. Contract EY-76-S-02-2272. 28p. Dep. NTIS, PC A03/MF A01.

The divergence of a neutral beam due to imperfect magnetic shielding of the gas cell neutralizer is considered. Coupled kinetic equations for the ion and neutral velocity distribution functions are solved. The deflection and divergence of the neutral beam are obtained from moments of the neutral distribution function.

43993 Quasi-linear relaxation of a fast ion beam in a Tokamak. Kulygin, V.M.; Mikhailovskii, A.B.; Pyatak, A.I.; Fridman, A.M.; Tsapelkin, E.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Zh. Eksp. Teor. Fiz.;* 70: No. 6, 2152-2160(Jun 1976). (In Russian).

Quasilinear relaxation of a beam of fast ions produced in the Tokamak on injection of a beam of fast neutral atoms is investigated theoretically. Relaxation of this type is assumed to be due to interaction between the ions and Alfven waves. A beam moving along the magnetic field is considered. Shearing of the magnetic strength lines is neglected. It is shown that under these assumptions quasilinear relaxation is much more rapid than Coulomb relaxation due to pair collisions. It is concluded that the concept of a "binary Tokamak", which is based on the assumption of Coulomb relaxation of the fast ions, generally speaking, requires revision.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

43994 (PPPL—1422) **Tritium permeation and wall loading in the TFTR vacuum vessel.** Cecchi, J.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). May 1978. Contract EY-76-C-02-3073. 61p. Dep. NTIS, PC A04/MF A01.

The problems of tritium permeation through and loading of the TFTR vacuum vessel wall structural components are considered. A general analytical solution to the time dependent diffusion equation which takes into account the boundary conditions arising from the tritium filling gas as well as the source function associated with implanted energetic charge exchange tritium is presented. Expressions are derived for two quantities of interest: (1) the total amount of tritium leaving the outer surface of a particular vessel component as a function of time, and (2) the amount retained as a function of time. These quantities are evaluated for specific TFTR operating scenarios and outgassing modes. The results are that permeation through the vessel is important only for the bellows during discharge cleaning if the wall temperature rises above approximately 150°C. At 250°C, after 72 hours of discharge cleaning 195 Ci would be lost.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 43398, 43450, 43452, 43461, 43462, 44009

43995 (IAEA—200, pp 81-106) **Overview of the planning considerations in the United States inertial confinement fusion program.** 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

An overview of the United States research program in inertial confinement experiments is presented. The objective is to develop and demonstrate inertial confinement fusion as a proven energy technology.

43996 (LA-UR—78-1152) **Fiber optics and microprocessors: a control-system solution for the laser-fusion environment.** Thuot, M.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 16p. (CONF-780539—1). Dep. NTIS, PC A02/MF A01.

From NEPCON east conference; New York, NY, USA (9 May 1978).

The use of fiber optics and microprocessors in a distributed computer control system for a 100-kJ CO_2 laser fusion facility is described. Gas-laser control systems must operate in an environment in which megavolt Marx circuits generate megampere discharges in the laser amplifiers, with attendant high electromagnetic fields. By linking the distributed controls with fiber optics we minimize the adverse effect of these fields on the hard-wired controls and gain the additional advantage of ground isolation. Our fiber-optic subsystems and interfaces include low-error-rate digital communication links between computers; nanosecond timing and trigger links; fiber-optic parameter monitors with dc-to-10 MHz bandwidths; binary fiber-optic power control for valves, motors, and contractors; and binary fiber-optic status interfaces to monitor the system response to control outputs.

43997 (N—77-31980) **Preliminary design of experiment high power.** Mosavi, R.K.; Kohanzadeh, Y.; Taherzadeh, M.; Vaziri, A. (Atomic Energy Organization of Iran, Teheran). Mar 1976. 14p. (AEOI—18). NTIS PC A02/MF A01.

This experiment is designed to produce plasma by carbon dioxide pulsed laser, to measure plasma parameters and to study the interaction of the produced plasma with intense laser beams. The objectives of this experiment are the following: (1) to set up a TEA CO2 laser oscillator and a cold cathode electron beam laser amplifier together as a system, to produce high energy optical pulses of short duration; (2) to achieve laser intensities of 10 to the 11th power watt/sq cm or more at solid targets of polyethylene (C2H4)n, lithium hydride (LiH), and lithium deuteride in order to produce high temperature plasmas; (3) to design and develop diagnostic methods for studies of laser-induced plasmas; and (4) to develop a high power CO2 laser amplifier for the purpose of upgrading the optical energy delivered to the targets.

43998 (RL—77-122-B) **Implosion and compression of gas filled microballoons. Paper No. IV.9.** Key, M.H.; Evans, R.G.; Nicholas, D.J. (Science Research Council, Chilton (UK). Rutherford Lab.). 1977. 62p. (CONF-770945—8). Dep. NTIS (US Sales Only), PC A04/MF A01.

From 11. European conference on laser interaction with matter; Oxford, UK (19 Sep 1977).

Central laser facility report No. LD/77/01.

Experimental studies have been made with a variety of diagnostic techniques on laser driven implosion of glass microballoons with typically 300 gigawatt 100 picosecond Nd glass laser pulses. The properties of the implosion core have been studied by X-ray pinhole photography, space resolved X-ray spectroscopy of line and continuum emission from filling gases and wall material, and by measuring D-T fusion neutron yields. Absorption and harmonic generation in the corona and the ionic composition of the fast ion flux have been measured. Computer simulations with a 1D lagrangian code, MEDUSA, have been used in analysing the data.

43999 (UCRL—80453) **Shiva target alignment and viewing instrument.** Monjes, J.A.; Manes, K.R.; O'Neal, W.C.; Rienecker, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1978. Contract W-7405-ENG-48. 18p. (CONF-780324—1). Dep. NTIS, PC A02/MF A01.

From SPIE '78 seminars; Washington, DC, USA (28 Mar 1978).

To view and align Shiva laser targets, two new telemicroscopic instruments integral with TV camera and HeNe laser illuminator have been designed. The common requirement of both instruments is the capability of imaging two objects of different sizes on a TV screen: the large surrogate target (5 mm diameter) and the laser fusion target (0.250 mm diameter) with the same resolution (better than 7 μm). Both instruments have an optical relay which images the targets on a fixed reference reticle; the object is to center each target on the reticle. One of the instruments reimages the reticle plane onto the TV dectector using a zoom arrangement. This instrument translates the TV camera-zoom assembly in three axes and is thereby capable of exploring an object-space volume of 1 cm^3. In the other instrument, the reticle plane is reimaged by a zoom lens and this enlarged image is relayed to the TV detector by a cluster of five lenses. Four lateral lenses image the periphery of the surrogate target and the reticle for coincidence. The central objective images the center of the reticle and the fusion target when it is centered.

44000 (WIS-PH—77/28) **Energy deposition by fast ions in pellet fusion targets.** Nardi, E.; Peleg, E.; Zinamon, Z. (Weizmann Inst. of Science, Rehovoth (Israel)). 1977. 23p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The energy loss of energetic ions in heavy metal targets is calculated at temperatures and densitities of interest for pellet fusion. The contributions of bound and free electrons to the stopping power are considered. It is found that in the temperature range of interest the increase of the number of free electrons in the target plasma causes range shortening with increasing temperatures and specific volumes. In order to study this effect on the ablation process, a one dimensional calculation of the hydrodynamic flow with energy deposition was carried out.

44001 (WIS-PH—77/31) **Self magnetic field effects on energy deposition by intense relativistic electron beams.** Nardi, E.; Peleg, E.; Zinamon, Z. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1977. 18p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The effect of the penetration of the self magnetic field of an intense relativsistic electron beam on the process of beam-target interaction is calculated. The diffusion of the magnetic field and the hydrodynamic expansion of the target are dynamically taken into account. It is found that at beam intensities of interest for pellet fusion considerable range shortening occurs by magnetic stopping.

44002 (WIS-PH—77/47) **Energy deposition by relativistic electrons in high temperature targets.** Nardi, E.; Zinamon, Z. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1977. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Under the conditions existing in electron beam pellet fusion targets, temperature and density effects on the energy loss and multiple scattering are shown to cause significant effective range shortening. A significant drop in the bremsstrahlung yield is also calculated.

44003 **Long road to fusion.** *Laser Focus;* **14**: No. 4, 40, 42, 44-47(Apr 1978).

Highlights are presented of the meeting sponsored by the Optical Society of America and the Institute of Electrical and Electronics Engineers in conjunction with the Conference on Laser and Electro-Optical systems. The use of electron beams, ion beams, and laser beams as fusion drivers is discussed. Some recent developments in the field are described. (MOW)

44004 **Non-spherical implosion of a dense thermonuclear plasma.** Winterberg, F. (Nevada Univ., Reno (USA). Desert Research Inst.). *J. Plasma Phys.;* **18**: No. 3, 473-485(Dec 1977).

In contrast to the electronic heat conduction losses which for a tamped thermonuclear micro-explosion are minimized by a spherical target shape, the adiabatic temperature rise can be larger for a non-spherical implosion geometry, whereas for a given plasma volume and density the Bremsstrahlung losses are independent of the particular geometry. For the special case of an imploding oblate ellipsoid the optimal eccentricity is derived from an exact analytical solution. The predicted effect leads to a reduction in required beam power density, permitting less beam focusing than is necessary for spherical targets, which is of special importance for electron- and ion-beam induced micro-explosions, and may even make possible the attainment of thermonuclear temperatures by chemical explosives.

44005 **Momentum measurements of laser produced plasma.** Zweigenbaum, S.; Gazit, Y.; Komet, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). *Plasma Phys.;* **19**: No. 11, 1035-1042(Nov 1977).

The momentum transfer, the angular distribution of the blow-off plasma and cratering effects caused by the impact on an Al slab target of focused high power Nd:glass laser light with power densities in the range of $2 \times 10^{12} - 4 \times 10^{13}$ W cm^{-2} are studied. Momentum measurements are performed using a physical ballistic pendulum, capable of measuring momenta as small as 3×10^{-3} dyn s. The target recoil momentum was found to depend on the 3/4 power of the laser energy, in good agreement with theoretical calculations. In the range of intensities of these experiments, no indication of nonlinear forces in the plasma is found. The observed crater diameter is found to depend on the fourth root of the laser energy and its size indicates that it is a result of the action of the laser-induced shock wave.

44006 **Self-generated magnetic fields in plasmas.** Pert, G.J. (Hull Univ. (UK). Dept. of Applied Physics). *J. Plasma Phys.;* **18**: No. , p. 227-241(Oct 1977).

The generation of magnetic fields by currents driven by the electron pressure gradient in non-uniform plasmas is considered. The equations for field generation and energy balance are derived under the MHD approximation. It is shown that there exists a class of waves, thermal magnetic waves, which propagate along surfaces of constant density. The properties of such waves are examined. In addition, a class of self-similar solutions are presented. These represent an unstable growth of magnetic field in localized plasma regions, i.e. magnetic hot spots.

44007 **Rayleigh-Taylor instabilities in inertial-confinement fusion targets.** Freeman, J.R.; Clauser, M.J.; Thompson, S.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). *Reza Kenkyu;* **4**: No. 4, 278-301(Mar 1977).

From U.S.-Japan seminar on laser interaction with matter; New York, USA (1 - 5 Nov 1976).

This paper reports calculations of the growth of Rayleigh-Taylor instabilities (1) in the ablator-pusher region such as may be caused by irregularities in an electron beam, and (2) in the pusher

fuel interface, a problem common to all inertial confinement fusion targets. For the first case, it is found that shallow density gradients and scattering of the beam by the target, both stabilize the shorter wavelength instabilities, which would otherwise grow the most rapidly. In the second case, it is found that moderately short wavelength instabilities may not degrade the target performance as much as has previously been supposed.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 43315

44008 (GA-A—14865) **Maintenance concepts for an ignition test reactor.** Sager, P.H. Jr.; Mullen, R.E. (General Atomic Co., San Diego, Calif. (USA); Aerojet Mfg. Co., Fullerton, Calif. (USA)). Mar 1978. Contract EY-76-C-03-0167-038. 17p. (CONF-780508—11). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A remote maintenance concept has been developed for the Ignition Test Reactor (ITR) which provides for maximum contact maintenance in all areas exterior to the shielding so as to minimize the remote maintenance equipment cost and maximize the facility availability. This concept involves the use of a highly effective reactor shield which minimizes the activation of components outside the shield envelope and permits contact maintenance in that region 24 hours after reactor shutdown. The major pieces of remote maintenance equipment required for access to the unshielded areas and for repair or replacement of critical components of the reactor are identified and described. The major pieces of equipment include a bridge-mounted shielded cab, a vehicle shielded cab, access port removal/replacement equipment, access port mounted manipulator, in-vessel rail mounted machine, upper maintenance shield module, and outboard maintenance shield module. Several major remote operations required for reactor maintenance are described to reflect how the remote maintenance equipment is used and illustrate how the reactor is designed to accommodate potential maintenance requirements. The specific maintenance operations are the removal of the upper shield, removal of the outboard shield, and removal of the inboard shield blocks.

44009 (SAND—78-0674C) **Surface damage and thermal effects from transient thermonuclear radiation in inertial confinement fusion reactors.** Hunter, T.O.; Kulcinski, G.L. (Wisconsin Univ., Madison (USA)). 1978. Contract EY-76-C-04-0789. 22p. (CONF-780431—1). Dep. NTIS, PC A02/MF A01.

From 3. conference on plasma interaction in controlled fusion devices; Abingdon, Oxfordshire, UK (3 Apr 1978).

A general model for transient deposition of thermonuclear radiation has been developed and applied to calculate the response of copper to a reference spectrum typical of laser fusion reactors. At 7 meters from a 100 MJ pellet, temperature excursions of approximately 700°C above the ambient temperature are noted for both photons and ions, occurring 0.02 and 2 microseconds after the thermonuclear burn respectively. Total displacement rates approach 100 dpa/sec at the surface and 500 dpa/sec at 1 micrometer into the copper. Filling the chamber with Ne at 0.5 Torr was found to be sufficient to reduce the temperature excursion in copper by 50% and the dpa rate at the front surface by 25%. The combination of surface temperature transients and ion bombardment were found to increase the sputtering yield by a factor of 6 over ambient temperature values indicating that previous calculations may have seriously underestimated the sputtering damage in laser fusion first walls.

44010 (UCRL—13802-1) **First wall thermal stress analysis for suddenly applied heat fluxes.** Dalessandro, J.A. (General Atomic Co., San Diego, Calif. (USA)). [nd]. Contract W-7405-ENG-48. 8p. Dep. NTIS, MF A01.

Portions of document are illegible.

The failure criterion for a solid first wall of an inertial confinement reactor is investigated. Analytical expressions for induced thermal stresses in a plate are given. Two materials have been chosen for this investigation: grade H-451 graphite and chemically vapor deposited (CVD) β-silicon carbide. Structural failure can be related to either the maximum compressive stress produced on the surface or the maximum tensile stress developed in the interior of the plate; however, it is shown that compressive failure would predominate. A basis for the choice of the thermal shock figure of merit, k(1 - ν) sigma/E α kappa/sup 1/2/, is identified. The result is that graphite and silicon carbide rank comparably.

44011 (UCRL—50016-77-4, pp 9-13) **Nickel—chromium strain gages for cryogenic stress analysis of superconducting structures in high magnetic fields.** 31 Dec 1977.

In Mechanical Engineering Department quarterly report, October—December 1977.

Magnetoresistance measurements of strain gages were made. The magnitude and variation of the magnetoresistance of a large number of strain gages were measured for the following conditions: (1) dc magnetic fields up to 12 T, (2) three orthogonal field directions, (3) increasing and decreasing fields, (4) a wide range of strain levels, and (5) liquid helium temperature. (MOW)

44012 **Important aspects of radiation shielding for fusion reactor tokamaks.** Abdou, M.A. (Argonne National Lab., Ill. (USA). Applied Physics Div.). *Atomkernenergie;* **30**: No. 4, 308-312(1977).

From 5. international reactor shielding conference; Knoxville, Tenn. (18 - 22 Apr 1977).

Radiation shielding is a key subsystem in tokamak reactors. Design of this shield must evolve from economic and technological trade-off studies that account for the strong interrelations among the various components of the reactor system. These trade-offs are examined for the bulk shield on the inner side of the torus and for the special shields of major penetrations. Results derived are applicable for a large class of tokamak-type reactors.

GENERAL AND MISCELLANEOUS

MANAGEMENT

44013 **Challenge of nuclear energy to Quebec industry.** Montreal, Canada; Ecole Polytechnique ([nd]). vp. (CONF-7605174—).

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

Individual papers were abstracted separately for the data base.

44014 **Role of the Atomic Energy Control Board.** Jennekens, J.H.F. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). pp 14 of Challenge of nuclear energy to Quebec industry. Proceedings of first Augustin-Frigon symposium, May 12, 13 and 14, 1976, Session II, Paper 1. Montreal, Canada; Ecole Polytechnique ([nd]).

From 1. augustin-frigon symposium; Montreal, Canada (12 May 1976).

See CONF-7605174—.

The history of the Canadian AECB is outlined, and its licensing program is described.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 43481

44015 (LA-UR—78-1100) **Implementation of distributed processing for administrative applications.** Hall, J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 16p. (CONF-780423—2). Dep. NTIS, PC A02/MF A01.

From AESOP conference; Amarillo, TX, USA (18 Apr 1978).

The concept of distributed data processing and its implementation at LASL are described. Software and hardware systems used are discussed. Three typical applications are presented: potential emloyee data entry, data entry and local processing in the Supply and Property Department, and distributed data base application for the Information Services Department. 6 figures, 2 tables. (RWR)

44016 (LA-UR—78-1180) **Forecasting methods for computer technology.** Worlton, W.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 18p. (CONF-780423—1). Dep. NTIS, PC A02/MF A01.

From AESOP conference; Amarillo, TX, USA (18 Apr 1978).

How well the computer site manager avoids future dangers and takes advantage of future opportunities depends to a considerable degree on how much anticipatory information he has available. People who rise in management are expected with each successive promotion to concern themselves with events further in the future. It is the function of technology projection to increase this stock of information about possible future developments in order to put planning and decision making on a more rational basis. Past efforts at computer technology projections have an accuracy that declines exponentially with time. Thus, precisely defined technology projections beyond about three years should be used with considerable caution. This paper reviews both subjective and objective methods of technology projection and gives examples of each. For an integrated view of future prospects in computer technology, a framework for technology projection is proposed.

44017 (SAND—78-0326) **Numerical codes for MHD flows. Quarterly technical progress report, October—December 1977.** Touryan, K.J.; Blottner, F.B.; Russo, A.J.; Taylor, J.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 32p. Dep. NTIS, PC A03/MF A01.

The objective of this study is to develop numerical techniques and codes for characterizing coal-combustion-operated MHD generators and diffusers. The purpose for this activity is two-fold: (a) provide the MHD Division of the Department of Energy with evaluative guidelines in selecting and exercising channel codes; (b) provide users with codes to design MHD channel/diffusers and evaluate their performance. The scope of work calls for four tasks: (1) unsteady one-dimensional channel code: to modify an existing time-dependent code to include MHD effects for approximate predictions of the flow from the combustion chamber through the diffuser; (2) multidimensional channel codes: to develop codes for predicting the complete inviscid-viscous flow across the duct in an MHD generator and diffuser; (3) slag layer studies and heat transfer analysis: to adapt an existing code to predict the stability conditions of slag layers which are driven by turbulent exterior flows and to develop a code for predicting slag layer growth; and (4) arc formation, migration, and electrode erosion: to conduct transient analyses in evaluating the inter-electrode arcing and constricted discharges from the gas to the electrode in the presence of Hall current. Progress to date is reported.

44018 (SAND—78-8226) **Shifted incomplete Cholesky factorization.** Manteuffel, T.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 79p. Dep. NTIS, PC A05/MF A01.

A technique for solving the large sparse linear systems that arise from the application of finite element methods is described. The technique combines an incomplete factorization method called the shifted incomplete Cholesky factorization with the method of generalized conjugate gradients. The shifted incomplete Cholesky factorization produces a splitting of the matrix A that is dependent upon a parameter α. It is shown that, if A is positive definite, then there is some α for which this splitting is possible and that this splitting is at least as good as the Jacobi splitting. The method is shown to be more efficient on a set of test problems than either direct methods or explicit iteration schemes.

44019 **Symmetries for conditioned ruin problems.** Beyer, W.A.; Waterman, M.S. (Los Alamos Scientific Lab., NM). *Math. Mag.;* **50**: No. 1, 42-45(Jan 1977).

Some interesting symmetries that arise in conditioning random walks on the integers with absorbing boundaries are discussed. These results are ancillary to a study done on conditional expected duration of walks used in a mathematical model of cancer tumors.

44020 **Frequentist probability and frequentist statistics.** Neyman, J. *Synthese;* **36**: 97-131(1977).

A brief, nontechnical outline is given of the author's views on the "frequentist" theory of probability and the "frequentist" theory of statistics; their applications are illustrated in a few domains of study of nature. The phenomenon of apparently stable relative frequencies as the source of the frequentist theories of probability and statistics is taken up first. Three steps are set out: empirical establishment of apparently stable long-run relative frequencies of events judged interesting, as they develop in nature; guessing and then verifying the chance mechanism, the repeated operation of which produced the observed frequencies--this is a problem of frequentist probability theory; using the hypothetical chance mechanism of the phenomenon studied to deduce rules of adjusting our actions to the observations to ensure the highest "measure" of "success". Illustrations of the three steps are given. The theory of testing statistical hypotheses is sketched: basic concepts, simple and composite hypotheses, hypothesis tested, importance of the power of the test used, practical applications of the theory of testing statistical hypotheses. Basic ideas and an example of the randomization of experiments are discussed, and an "embarrassing" example is given. The problem of statistical estimation is sketched: example of an isolated problem, example of connected problems treated routinely, empirical Bayes theory, point estimation. The theory of confidence intervals is outlined: basic concepts, anticipated misunderstandings, construction of confidence intervals: regions of acceptance. Finally, the theory of estimation by confidence intervals or regions is considered briefly. 4 figures. (RWR)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Adaptronics, Inc., McLean, Va. (USA)
Feasibility of using adaptive learning networks for eddy current signal analysis. Final report, 3:42707 (EPRI-NP—723)
Feasibility of using adaptive learning networks for eddy current signal analysis. Final report, 3:42671 (EPRI-NP—733)

Aerochem Research Labs., Inc., Princeton, N.J. (USA)
Development of a model and computer code to describe solar grade silicon production processes. First quarterly report, 3:42439 (DOE/JPL/954862—1)

Aerojet Mfg. Co., Fullerton, Calif. (USA)
Maintenance concepts for an ignition test reactor, 3:44008 (GA-A—14865)

Aerospace Corp., El Segundo, Calif. (USA). Chemistry and Physics Lab.
Reactive single collision studies with metal atoms or metal halides. Interim report, 3:43823 (AD-A—048230)

Aerospace Corp., El Segundo, Calif. (USA). Energy and Transportation Div.
Mission analysis of photovoltaic solar energy conversion. Volume IV. Supplementary studies, 3:42449 (SAN—1101/PA8-1/4)
Systems management support for ERCDC study of undergrounding and berm containment. Interim report. Preliminary program assessment and follow-on program development, 3:42975 (ATR—77(7652-01)-1)

Agbabian Associates, El Segundo, Calif. (USA)
Seismic design verification of LMFBR structures, 3:42988 (SAN—1011-117)
Study of vertical ground response spectrum shapes, 3:42987 (SAN—1011-114)

AiResearch Mfg. Co., Torrance, Calif. (USA)
Large hydrofoil transmission system study. Final report, 3:43186 (AD-A—046919)

Air Force Geophysics Lab., Hanscom AFB, Mass. (USA)
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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047485	3:43243	NTIS PCA04/MF A01
047508	3:43797	NTIS PCA06/MF A01
047526	3:43798	NTIS PCA10/MF A01
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047556	3:43369	NTIS PCA03/MF A01
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047585	3:42267	NTIS PCA03/MF A01
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047963	3:43303	NTIS PCA02/MF A01
047964	3:43519	Availability: Microfiche copies only.
047975	3:43809	NTIS PCA05/MF A01
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517	3:42668	Dep. NTIS (US Sales Only), PC A03/MF A01
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5682	3:42848	Dep. NTIS (US Sales Only), PC A02/MF A01
5832	3:42740	Dep. NTIS (US Sales Only), PC A02/MF A01
5856	3:42973	Dep. NTIS (US Sales Only), PC A05/MF A01
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77-301-000	3:43975	Wiesbaden, Germany, F.R.; Campaigner Verl. (1977).
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18	3:43997	*See* N-77-31980
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AFIT-LSSR-		
32-77B	3:42483	*See* AD-A-047433
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76-304	3:43808	*See* AD-A-047395
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78-5	3:42757	AT
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190-1	3:42866	Dep. NTIS, PC A13/MF A01
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77(7652-01)-1	3:42975	Aerospace Corp., El Segundo, CA
BDM/W-		
77-425-TR	3:43084	*See* PB-272985
77-425-TR(Vol.1)	3:43082	*See* PB-272983
77-425-TR(Vol.2)	3:43083	*See* PB-272984
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613-1816	3:43342	Dep. NTIS, PC A02/MF A01
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76/33	3:43219	*See* PB-274374
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51-77-5	3:43538	*See* AD-A-047427
CENPD-		
172-A	3:42976	Combustion Engineering, Inc., Windsor, CT
CMR-		
77-7	3:43427	*See* AD-A-047049
CONF-760576-		(IAEA meeting on LMFBR fuel reprocessing, Leningrad, USSR, 17-21 May 1976)
18	3:42314	*See* IAEA-AG-63-8
19	3:42312	*See* IAEA-AG-63-6
20	3:42334	*See* IAEA-AG-63-2
21	3:42317	*See* IAEA-AG-63-11
22	3:42315	*See* IAEA-AG-63-9
23	3:42320	*See* IAEA-AG-63-27
26	3:42313	*See* IAEA-AG-63-7
27	3:42316	*See* IAEA-AG-63-10
28	3:42310	*See* IAEA-AG-63-4
29	3:42386	*See* IAEA-AG-63-24
31	3:42318	*See* IAEA-AG-63-16
33	3:42327	*See* IAEA-AG-63-15
34	3:42769	*See* IAEA-AG-63-12

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35	3:42319	*See* IAEA-AG-63-26
38	3:43416	*See* IAEA-AG-63-14
CONF-7605174-	(1. augustin-frigon symposium, Montreal, Canada, 12-14 May 1976)	
	3:44013	Montreal, Canada; Ecole Polytechnique ([nd]).
CONF-7608111-	(Environmental management of the coastal zone conference, Philadelphia, PA, USA, 9-12 Aug 1976)	
	3:43596	Drexel Univ., Philadelphia, PA
CONF-7610123-	(Annual meeting of the Geochemical Society of Japan, Nagoya, Japan, 25 Oct 1976)	
1	3:42569	TIC
3	3:42570	TIC
CONF-761194-	(Conference on world nuclear power, Washington, DC, USA, Nov 1976)	
1	3:42973	*See* AECL-5856
CONF-770135-	(Geothermal Resources Development Institute conference, Salt Lake City, UT, USA, 27-28 Jan 1977)	
	3:42578	Laramie, WY; Univ. of Wyoming (1977).
CONF-770140-	(National solar grain drying conference, Champaign, IL, USA, 11-12 Jan 1977)	
	3:42498	Dep. NTIS, PC A10/MF A01
CONF-770321-	(NBS international specialists symposium on neutron standards and applications, Gaithersburg, MD, USA, 28-31 Mar 1977)	
10	3:43849	*See* BNL-22742
CONF-770364-	(Meeting of the developmental results of geothermal energy in 1974 and 1975, Tokyo, Japan, Mar 1977)	
2	3:42587	TIC
3	3:42582	TIC
5	3:42574	TIC
6	3:42584	TIC
10	3:42560	TIC
11	3:42561	TIC
13	3:42556	TIC
19	3:42579	TIC
20	3:42580	TIC
CONF-770397-	(Nonlinear waves in solids workshop, Chicago, IL, USA, 21-23 Mar 1977)	
1	3:43277	*See* SAND-77-0199C
CONF-770398-	(10. IAEA working group on fast reactors, Vienna, Austria, 29 Mar-1 Apr 1977)	
	3:42792	*See* IWGFR-18
CONF-770399-	(22. nuclear congress, Rome, Italy, 24 Mar 1977)	
1	3:42740	*See* AECL-5832
CONF-770460-	(Spring meeting of the Mining and Metallurgical Institute of Japan, Tokyo, Japan, Apr 1977)	
7	3:42598	TIC
CONF-770486-	(Meeting of the American Neurological Association, Chicago, IL, USA, Apr 1977)	
1	3:43731	*See* UR-3490-1343
CONF-770505-	(International conference on nuclear power and its fuel cycles, Salzburg, Austria, 2-13 May 1977)	
54(trans)	3:42901	*See* IAEA-CN-36/342
CONF-770510-	(American Chemical Society meeting, Montreal, Canada, May 1977)	
P1	3:42271	University Microfilms, Ann Arbor, MI, $8.00
CONF-7705116-	(AIF's workshop on insurance, Atlanta, GA, USA, 8-11 May 1977)	
1	3:43042	Washington, DC; Atomic Industrial Forum, Inc. (1977).
2	3:42329	Washington, DC; Atomic Industrial Forum, Inc. (1977).
12	3:43024	Washington, DC; Atomic Industrial Forum, Inc. (1977).
CONF-7706121-	(Conference on energy and technological development: solution to the energy crisis, Essen, F.R. Germany, 6 Jun 1977)	
	3:43975	Wiesbaden, Germany, F.R.; Campaigner Verl. (1977).
CONF-770708-	(Thermal reactor safety meeting, Sun Valley, ID, USA, 31 Jul-5 Aug 1977)	
17	3:42741	*See* AECL-5914
CONF-770833-	(4. conference on surface properties of materials, Rolla, MO, USA, 1-4 Aug 1977)	
(Absts.)	3:43240	Univ. of Missouri, Rolla
CONF-770847-	(15. international thermal conductivity conference, Ottawa, Ontario, Canada, 24-26 Aug 1977)	
7	3:42563	*See* LA-UR-78-1240
CONF-770891-	(20. symposium on circuits and systems, Albuquerque, NM, USA, 15-17 Aug 1977)	
1	3:43481	*See* SAND-77-0702J
CONF-770892-	(Fuel cell powered vehicle workshop, Los Alamos, NM, USA, 15-17 Aug 1977)	
1	3:43156	*See* BNL-24224
CONF-770921-	(3. biennial wind energy conversion systems conference, Washington, DC, USA, 19-21 Sep 1977)	
7	3:42607	*See* DOE/NASA/1028-78/16
CONF-770939-	(3. power plant dynamics, control and testing symposium, Knoxville, TN, USA, 7-9 Sep 1977)	
3	3:42856	*See* AECL-5907
CONF-770945-	(11. European conference on laser interaction with matter, Oxford, UK, 19-23 Sep 1977)	
8	3:43998	*See* RL-77-122-B
CONF-770987-	(International symposium on nuclear collisions and their microscopic description, Bled, Yugoslavia, 26 Sep-1 Oct 1977)	
4	3:43851	*See* LBL-7164
CONF-7709115-	(Conference on materials substitution: availability, energy and environmental factors, Chicago, IL, USA, 27-28 Sep 1977)	
1	3:43273	*See* LBL-7397
CONF-771029-	(7. symposium on fusion research project, Knoxville, TN, USA, 25-29 Oct 1977)	
209	3:43989	Dep. NTIS, PC A02/MF A01
CONF-771075-	(6. annual conference of the International Nuclear Target Development Society, Berkeley, CA, USA, 19-21 Oct 1977)	
4	3:43500	Dep. NTIS, PC A02/MF A01
CONF-771089-	(Particles and fields meeting, Argonne, IL, USA, 6-8 Oct 1977)	
6	3:43839	*See* SLAC-PUB-2086
CONF-7710101-	(5. national conference on energy and the environment, Cincinnati, OH, USA, 31 Oct-3 Nov 1977)	
10	3:42219	Dep. NTIS, PC A02/MF A01
CONF-771125-	(3. international conference of environmental problems of the extractive industries-materials, energy and environment, Dayton, OH, USA, 29 Nov-1 Dec 1977)	
3	3:43193	Dep. NTIS, PC A02/MF A01
CONF-771127-	(23. conference on magnetism and magnetic materials, Minneapolis, MN, USA, 8-11 Nov 1977)	
17	3:43329	Dep. NTIS, PC A02/MF A01
CONF-771204-	(3. international symposium on computing methods in applied sciences and engineering, Versailles, France, 5-9 Dec 1977)	
3	3:43470	Dep. NTIS, PC A02/MF A01
CONF-771236-	(Conference on copper and estuarine continental and marine water, San Francisco, CA, USA, 7-8 Dec 1977)	
(Absts.)	3:43600	Dep. NTIS, PC A03/MF A01
CONF-771238-	(Workshop on plasma heating development requirements, Washington, DC, USA, 5-7 Dec 1977)	
1	3:43990	Dep. NTIS, PC A02/MF A01
CONF-771243-	(3. workshop on geothermal reservoir engineering, Palo Alto, CA, USA, 14-16 Dec 1977)	
1	3:42590	*See* UCRL-80529
CONF-771244-	(Symposium on NURE uranium geology, Grand Junction, CO, USA, 7-8 Dec 1977)	
	3:42287	*See* GJBX-12(78)
CONF-780114-	(International Solar Energy Congress, New Delhi, India, 16-21 Jan 1978)	
6	3:42524	Dep. NTIS, PC A02/MF A01
7	3:42429	*See* BNL-24216
8	3:42430	Dep. NTIS, PC A02/MF A01
9	3:42486	Dep. NTIS, MF A01
CONF-780134-	(Symposium commemorating the 25th anniversary of the discovery of elements 99 and 100, Berkeley, CA, USA, 23 Jan 1978)	
2	3:43385	Dep. NTIS, PC A03/MF A01
CONF-780135-	(3. NASA conference on radiation energy conversion, Moffett Field, CA, USA, 26-28 Jan 1978)	
2	3:43450	*See* COO-2007-93

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CONF-780202-		(Topical meeting on inertial confinement fusion, San Diego, CA, USA, 7 Feb 1978)
20	3:42394	*See* UCRL-80166
CONF-780210-		(3. conference on wind engineering research, Gainesville, FL, USA, 26 Feb-1 Mar 1978)
2	3:43551	*See* BNL-24190
CONF-780212-		(Plutonium information conference, San Diego, CA, USA, 28 Feb-2 Mar 1978)
3	3:43556	*See* LA-UR-78-959
CONF-780213-		(107. AIME meeting, Denver, CO, USA, 26 Feb-2 Mar 1978)
6	3:42182	Dep. NTIS, PC A02/MF A01
CONF-780222-		(5. energy technology conference, Washington, DC, USA, 27 Feb-1 Mar 1978)
2	3:42114	Gilbert Associates, Reading, PA
4	3:42115	Dep. NTIS, PC A02/MF A01
CONF-780231-		(Utility rate structuring, Washington, DC, USA, 28 Feb 1978)
1	3:42484	*See* BNL-24329
CONF-780234-		(Symposium on clinical chronopharmacy, chronotherapeutics, chronopharmacology, Tallahassee, FL, USA, 10-12 Feb 1978)
1	3:43662	Dep. NTIS, PC A03/MF A01
CONF-780236-		(5. OETC conference, Miami, FL, USA, 20-22 Feb 1978)
1	3:42479	Dep. NTIS, PC A02/MF A01
CONF-780306-		(Symposium on late biological effects of ionizing radiation, Vienna, Austria, 13-17 Mar 1978)
7	3:43703	Dep. NTIS, PC A02/MF A01
8	3:43704	Dep. NTIS, PC A02/MF A01
CONF-780314-		(9. lunar science conference, Houston, TX, USA, Mar 1978)
3	3:43791	*See* LA-UR-78-1211
CONF-780316-		(Waste management fuel cycles, Tucson, AZ, USA, 5-8 Mar 1978)
10	3:42338	*See* LA-UR-78-1065
CONF-780324-		(SPIE '78 seminars, Washington, DC, USA, 28-31 Mar 1978)
1	3:43999	*See* UCRL-80453
CONF-780330-		(ASME symposium, Albuquerque, NM, USA, 16-17 Mar 1978)
2	3:42388	Dep. NTIS, PC A03/MF A01
CONF-780331-		(Conference of mathematical software, Austin, TX, USA, 29-31 Mar 1978)
3	3:43391	*See* BDX-613-2003
CONF-780332-		(Conference on the physics of SiO/sub 2/ and its interfaces, Yorktown Heights, NY, USA, 22-24 Mar 1978)
1	3:43323	*See* SAND-77-1815C
3	3:43331	*See* SAND-77-1885C
CONF-780336-		(2. seminar on MHD flows and turbulence, Beer-Sheva, Israel, 28-31 Mar 1978)
2	3:43149	Dep. NTIS, PC A02/MF A01
CONF-780337-		(2. national passive solar conference, Philadelphia, PA, USA, 15-19 Mar 1978)
4	3:42491	*See* LA-UR-78-965
CONF-780339-		(Conference on future trends in superconductive electronics, Charlottesville, VA, USA, 23-25 Mar 1978)
1	3:43402	Dep. NTIS, PC A02/MF A01
2	3:43403	Dep. NTIS, PC A02/MF A01
CONF-780415-		(Scanning electron microscopy conference, Los Angeles, CA, USA, 16-21 Apr 1978)
3	3:42133	Dep. NTIS, MF A01
CONF-780417-		(Western States Section/Combustion Institute, Boulder, CO, USA, 17-18 Apr 1978)
4	3:42403	*See* LBL-7801
5	3:43389	*See* LBL-6899
7	3:42143	*See* LBL-6897
9	3:42119	*See* LA-UR-78-1183
CONF-780423-		(AESOP conference, Amarillo, TX, USA, 18-20 Apr 1978)
1	3:44016	*See* LA-UR-78-1180
2	3:44015	*See* LA-UR-78-1100
CONF-780426-		(Advanced Transit Association international conference, Indianapolis, IN, USA, 25-28 Apr 1978)
1	3:43226	*See* UCRL-80874
CONF-780427-		(Conference of the American Society for nondestructive testing, New Orleans, LA, USA, 3-6 Apr 1978)
1	3:43244	Dep. NTIS, PC A02/MF A01
CONF-780428-		(Meeting on atmospheric sulfates, Philadelphia, PA, USA, 13-14 Apr 1978)
1	3:43574	*See* UCRL-80428
CONF-780430-		(Conference on metallurgical coatings, San Francisco, CA, USA, 3-7 Apr 1978)
1	3:43335	*See* LA-UR-78-884
3	3:43321	*See* SAND-78-0555C
CONF-780431-		(3. conference on plasma interaction in controlled fusion devices, Abingdon, Oxfordshire, UK, 3-7 Apr 1978)
1	3:44009	*See* SAND-78-0674C
3	3:43315	*See* GA-A-14608
5	3:43868	*See* UCRL-80656
CONF-780432-		(Conference on performance monitoring techniques for evaluation of solar heating and cooling systems, Washington, DC, USA, 3-4 Apr 1978)
2	3:42489	*See* LA-UR-78-677
3	3:42490	*See* LA-UR-78-754
CONF-780433-		(Conference on limited proteolysis in microorganisms, Washington, DC, USA, 17-18 Apr 1978)
2	3:43615	Dep. NTIS, PC A02/MF A01
CONF-780446-		(Workshop on affinity techniques, Goettingen, F.R. Germany, 10-12 Apr 1978)
1	3:43616	Dep. NTIS, PC A03/MF A01
CONF-780447-		(Solar Thermal Test Facilities Users Association meeting, Golden, CO, USA, 11-12 Apr 1978)
2	3:42461	*See* LA-UR-78-1052
3	3:42454	*See* LA-UR-78-1050
CONF-780452-		(Colorado-Wyoming academy of sciences meeting, Pueblo, CO, USA, 21 Apr 1978)
1	3:42322	*See* RFP-2770
CONF-780453-		(Neutrinos, West Lafayette, IN, USA, 28 Apr-2 May 1978)
3	3:43840	*See* ANL-HEP-CP-78-10
CONF-780506-		(5. symposium on packaging and transportation of radioactive materials, Las Vegas, NV, USA, 7-12 May 1978)
21	3:43415	Dep. NTIS, PC A02/MF A01
25	3:43414	*See* AGNS-1040-14
CONF-780507-		(Probabilistic analysis of nuclear reactor safety, Los Angeles, CA, USA, 8-10 May 1978)
14	3:42981	*See* GA-A-14568
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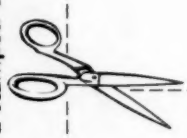

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